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Demand planning development from early stages of business growth

A case study at Azelio AB

Master's thesis in Supply Chain Management

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Abstract

Demand planning is a stepwise process aimed at foreseeing future demand. The process outcome is a final demand number that all functions plan towards, making an effective demand planning process indicative for balanced inventory and satisfied customers. Being a sub-process for Sales and Operations Planning (S&OP), demand planning has been less researched, and developing the process has been paid less attention.

Current literature fails to explain how companies in early business growth should develop and mature demand planning processes. Azelio is a start-up that wants to contribute by replacing fossil fuels with more green energy at a competitive price with their solution, the TES.POD. Azelio follows a long-term plan where the focus now is to industrialize and commercialize their solution. Therefore, Azelio is about to design and implement an S&OP-process that requires and includes a demand planning process. When Azelio started to develop their demand planning process, they identified uncertainties regarding how to tailor the process to fit their situation. The study aims to support Azelio in designing its demand planning process and be applicable for other companies facing similar challenges by increasing the understanding of the fit between demand planning processes and contextual variables.

To evaluate the organizational processes performance, maturity models have become increasingly popular. Maturity models explain the phases companies go through when developing processes and can be used to set goals for future aspirations. This study has compiled three maturity frameworks for demand planning, each with a different focus. Drawing inferences from aspects of the three models, five design variables were established that affect demand planning: information systems support, forecasting methods, collaboration and coordination, performance management, and skills. Developing maturity within each design variable is impacted by specific contextual variables, such as detail complexity, dynamic complexity, firm size, and industry type, that increase uncertainty of demand and the level of collaboration and coordination needed for a mature demand planning process.

The study resulted in a maturity framework based on available literature to map Azelio's current demand planning development. The framework contributes to understanding Azelio's current demand planning maturity and what is required to advance in the evolutionary phases. In this study, contextual variables were identified and investigated to determine their effect on each design variable. The theoretical contributions of this study highlight challenges companies in the early phases of business growth face when establishing a demand planning process. Six contextual variables were found in the case study that affects both the design and the possibility of advancing through the maturity framework. Additionally, facilitators for managing the contextual variables in demand planning were identified in the study. Besides academia's contribution, the study provides Azelio and other companies in the early phases of business growth insight into contextual variables that might affect the design of demand planning.

Keywords: Demand planning, Demand planning maturity, Demand planning challenges in early phases of business growth, Contextual variables affecting demand planning.

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Joel Jönsson *Isak Westerlund*

Contents

1. Introduction

This chapter describes the thesis background, aim, research questions, and limitations.

1.1 Background

Many companies implement a Sales and Operations Planning process (S&OP), which aligns supply with demand, bridging the gap between the business plan and operational plans (Thomé, Scavarda, Fernandez and Scavarda, 2012). A fundamental step of the S&OP process is demand planning, which is, according to Wallace and Stahl (2008), the most challenging and essential step of the process. Demand planning aims at accurately foreseeing future demand drawing on inferences from relevant qualitative and quantitative data (Kilger and Wagner, 2008; Wallace and Stahl, 2008). Therefore, data availability and quality are prerequisites for demand planning, enabling forecasting, a fundamental step for generating predictions. The choice of suitable forecasting methods that lead to increased forecast accuracy depends on the availability and quality of data (Vereecke, Vanderheyden, Baecke and Van Steendam, 2018; Kilger and Wagner, 2008). For new companies in early business growth phases that possess insufficient quantity and quality of demand data, implementing an effective demand planning process is challenging. Such companies require guidance in going from a demand planning process that is non-existent to an established process as the conditions of data and other related areas develop.

Another prerequisite for effective demand planning is the efficiency of managing demand data. Efficient demand planning is also a prerequisite for maturity in S&OP (Vereecke et al., 2018). Several S&OP maturity frameworks have been proposed in the literature, see Thomé et al., (2012). Vereecke et al. (2018) created a maturity assessment model focusing on demand planning, claiming that the maturity frameworks of S&OP do not adequately address demand planning development between levels.

Mentzer, Bienstock, and Kahn (1999) identified four dimensions of maturity in demand planning: functional integration, approach, system, and performance measurement. These, however, do not address organizational aspects, such as people and organization management, in detail. Although being comprehensive, none of the extant literature addresses new companies in the early business growth phases and how these companies should manage the advancement through maturity stages with no prior sales data. The frameworks for demand planning, either as an independent process or as part of S&OP, define maturity stages rather than describe how contextual variables affect the possibility of advancing the demand planning process. Therefore, this study aims at addressing this issue with the proposed aim stated in subsection 1.2.

1.2 Aim

This study aims to increase the understanding of the fit, between demand planning processes and contextual variables. This study addresses this problem by developing a framework that considers design variables in demand planning development from the early phases of business growth and by identifying contextual variables' affecting the demand planning development within each design variable.

1.3 Research questions

The following research questions are addressed to fulfill the aim of the study:

RQ1: What challenges do new companies experience when implementing a demand planning process?

RQ2: What are the prerequisites to develop demand planning maturity?

The answer to RQ1 increases the understanding of challenges new companies experience when establishing a demand planning process. This question's contribution to the aim is a list of contextual variables that affect demand planning design in early business phases. The answer of RQ2 highlights the fit between design variables of the demand planning process and contextual variables that shape the prerequisites to develop the process maturity. Answering both RQ1 and RQ2 extends knowledge on the fit between demand planning design and contextual variables. Such contribution guides practitioners in implementing demand planning at new companies and provides researchers with insights into the contingency relationships concerning business process design.

1.4 Limitations

The framework covers a full spectrum of maturity stages of the demand planning process but is showcased on a company with low demand planning maturity. This means guiding companies from non-existing demand planning with insufficient data; to an established demand planning process as data and other relevant areas develop. Therefore, future steps to reach higher maturity levels, where an abundance of data and information systems are in place, are not addressed in this thesis. This is because the preferred study approach is an exploratory, inductive type that requires empirical data richness and in-depth case analysis. These are arguably suitable methods to capture contextual variables that generate contingency (Sousa and Voss, 2008).

Another limitation is that the resulting framework provides insights into the dynamics of demand planning development within the context of S&OP in a specific industry. Accordingly, the external validity of such insights' is limited and cannot be extended to other types of environments and processes. The case study only serves as a practical example that operationalizes the framework to identify further theoretical refinements.

2. Theoretical Framework

This chapter covers the theoretical foundation for this study. The chapter is structured around three main sections: demand planning (structure, process, and control), maturity models within demand planning (including synthesis of three maturity frameworks), and related contextual variables.

2.1 Demand planning

This section describes demand planning in theory divided into three sub-elements: structure, process, and control.

2.1.1 Demand planning parameters

The objective of demand planning centers around foreseeing customers' future demand for sets of items and geographies during specific time series (Stadtler, Kilger, and Meyr, 2015). The selection of appropriate time series for demand planning is dependent on what is to be forecasted. For example, a tactical-level planning process might need forecasted demand of product families in monthly buckets divided into sales regions. On the other hand, daily execution of stock-keeping-unit (SKU) replenishment might require forecasted demand in time buckets of days divided into final products. Therefore, adapting the demand planning structures to the requirements of different functions is necessary. The demand plans are usually structured around three components; time, region, and product (Stadtler et al., 2015; Uzsoy, Fowler, and Mönch, 2018).

The *first parameter* that defines demand is the planning object (Stadtler et al., 2015). Forecasts can be produced on different levels of aggregation, depending on the context of the company. If a company has large amounts of SKUs, aggregating demand into product families might be necessary to keep the forecasting process efficient. Aggregating demand forecasts will often result in higher forecast accuracy as forecast errors on SKU levels will even out on a product family level.

Zotteri, Kalschschmidt, and Caniatio (2005) introduce two ways of aggregating forecasts; the bottom-up approach and the top-down approach. The bottom-up approach refers to aggregating individual forecasts of SKUs into a forecast of product groups. The top-down approach initially forecasts aggregate demand and then disaggregates the forecasts into individual demand segments, usually using historical sales volumes. These methods have their strengths and weaknesses. Using a top-down approach is preferred in stable demand periods as it requires lower effort and therefore costs less. However, this method makes it harder to predict seasonality for individual SKUs due to the smoothing effect of aggregate forecasts. Therefore, a combination of the methods is often preferable, as it supports different decision-making processes both at strategic, tactical, and operational levels (Jonsson and Matsson, 2009).

The *second demand parameter* is time, which defines the period within which the demand applies. Expressing demand in time typically takes the form of buckets, ranging from yearly to daily buckets (Jonsson and Matsson, 2009; Stadtler et al., 2015). The sum of time buckets dedicated to the demand plan forms the demand plan horizon. According to Jonsson and Matsson (2008), factors like the purpose of forecast and delivery frequency of forecasted items determine the size of time buckets. For example, if an item has intermittent demand with three orders per year, the weekly forecast would be both impossible and meaningless. According to Stadtler et al. (2015), time buckets should be at the granularity level at which it is enough for the supply chain to adhere to forecasted demand.

On the other hand, granularity should not be too detailed as performance could be affected poorly. The typical size of time buckets in many industries is one month. Such length is suitable for highlighting seasonal variations and balancing supply with demand at a tactical level (Stadtler et al., 2015). However, the size of time buckets and the length of the demand planning horizon are based on the lead time of meeting and preparing for future demand of each process.

The *third parameter* that defines demand is geography (Stadtler et al., 2015). This parameter is also, similar to the product parameter, aggregable into different levels. Demand can be consolidated into regions and areas to support tactical and strategic planning. Furthermore, demand can be divided into supply points, such as production facilities or distribution centers, to enable easy comparison between demand and capacity. Lastly, division by key accounts enables grouping together customers' businesses, and the lowest aggregation level is individual customers.

2.1.2 Demand planning processes

A demand planning process consists of several steps that vary in different industries and companies. Stadtler et al. (2015) propose a six-step model used in most industries for efficient demand planning, see figure 1.1. This study adopts this renowned model as the theoretical foundation to further describe the demand planning process.

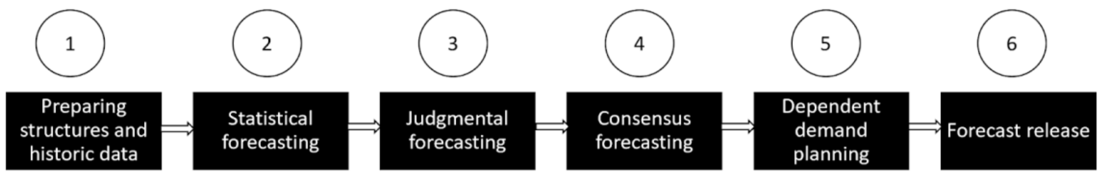

Figure 1.1: *A demand planning process by Stadtler et al. (2015).*

The *first step* of demand planning is a preparation stage that addresses new products, out-phased products, and product changes (Stadtler et al.,2015). The preparation stage is about managing and inserting historical data, such as customer orders, shipments, and previous forecast accuracy, into the demand planning system. The data go through checking and adjustment before being inserted into the demand planning system. The checking and adjustment highlight if anything affecting the planning process has occurred, e.g., a stock-out situation. If the data is not adjusted accordingly, the statistical forecast will be influenced and result in a misleading forecast. Wallace and Stahl (2008) and Stadtler et al. (2015) focus on adding and updating new product forecasts in this stage. They separate new products from established products as the data type required for those products are different. Factors to consider when forecasting new products are insights from employees that are usually not a part of the demand planning process, e.g., R&D. Moreover, cannibalization effects on established products need to be considered. The forecasts of new products are either addressed using special statistical forecasting techniques or judgments as such forecasts lack sufficient sales data. The supply side is often involved in the forecasting process for new products due to the increased uncertainty of demand.

The *second stage* entails creating a statistical forecast. The statistical forecasts are based on the data prepared in the preparation stage and are based on mathematical calculations, therefore less likely to be biased forecasts (Stadtler et al., 2015). According to Wheelwright, Makridakis, and Hyndman (1998), statistical forecasts are usually more accurate than judgmental forecasting methods as they tend not to have biases. Both Vlckova and Patak (2010) and Wallace and Stahl (2008) emphasize the importance of finding and understanding possible biases even in statistical forecasts since it could affect the accuracy of the forecast. According to Vlckova and Patak (2010), one way is to use several statistical forecasting methods for the same purpose and compare differences to secure a good result. However, statistical methods do not consider events, e.g., promotional activities and new products, which could cause variations in the demand pattern.

The *third step* of the demand planning process is judgmental forecasting (Stadtler et al., 2015). The judgmental forecasts usually are created by several departments such as marketing, sales, and product management. Salespeople are primarily involved as they possess much knowledge of the customers (Wallace and Stahl, 2008). Complementing statistical forecasts with judgments is only viable when considering new data sources in judgmental forecasts. Otherwise, the same data would be double-counted, resulting in either overestimating or underestimating the demand. Judgmental forecasts are, in most cases, created by the demand planner, tuning the numbers from their decision-tool/software by using their knowledge and instinct. This approach is called a non-structured approach. Stadtler et al. (2015) propose that approaching the judgmental forecast in a structured way to maximize the benefits of combining the two forecasts when combining statistical and judgmental forecasts is necessary that approaching the judgmental forecast in a structured way to maximize the benefits of combining the two forecasts when combining statistical and judgmental forecasts is necessary. Examples of methods that generate structured judgmental encompass revised judgmental forecasting, combined forecasting, and rule-based forecasting.

The *fourth step* is consensus forecasting. After combining the forecasts in the previous step, the new forecast is discussed in consensus forecasting (Stadtler et al., 2015). Several departments are present at the meeting, aiming at reaching a consensus concerning the quality of the forecast using their expertise and insights from their department (Stadtler et al., 2015; Wallace and Stahl, 2008). Wallace and Stahl (2008) state that getting the different departments to reach a consensus might be the most challenging task in the demand planning process. There is also a learning curve that positively affects the process as the people get used to working together and understand what is required for the forecasts to be usable. Wallace and Stahl (2008) recommend learning from the past by reviewing how past assumptions affected accuracy negatively and avoiding the same mistakes in the future.

The *fifth step* is planning the dependent demand. Since the consensus forecast considers finished products, estimating the demand on a component level is necessary. Stadtler et al. (2015) propose three methods of estimating dependent demand: constrained availability of a critical component, product bundling, and demand constraints that a critical component can express. Managing dependent demand also occurs during master planning, the reason this step could be optional. However, the authors emphasize the importance of estimating and checking dependent demand as a part of the demand planning process to achieve high efficiency.

The *sixth and last step* of the demand planning process is to release the forecast. This step represents a formal approval and a technical release. Wallace and Stahl (2008) define the last step as executive authorization. Accordingly, the step should be managed by a senior sales and marketing executive as it gives the forecast acceptability.

2.1.3 Demand planning controlling

Stadtler et al. (2015) define demand planning controlling as ensuring quality in the demand planning process. Many processes use the demand plan as direct input to base decisions on, making the quality of demand planning processes an essential measure. Companies often use a forecasting accuracy metric to ensure a quality demand planning process (Eickmann, 2004; Stadtler et al., 2015). Effective forecasting accuracy metrics need to have specific characteristics. First of all, the metric must indicate positive values. Otherwise, the negative values even out the positive ones when the data get consolidated. Secondly, the time series used for calculations of the primary forecast accuracy metric needs to be prevalent at all planning instances, i.e., every product, customer, and time bucket. Thus, historical shipments might not be available for new products and are therefore insufficient to use when measuring forecast accuracy. Lastly, every function in the company should have buy-in to what primary metric will measure forecast accuracy. For example, a metric like a delivery service might not be committed to by the sales function as they are not responsible for poor delivery service.

Accuracy measures stem from forecasting errors (Stadtler et al.,2015). The most common methods for measuring forecast errors in the industry are: mean squared error (MSE), mean absolute deviation (MAD), and mean absolute percentage error (MAPE). The measures are affected by the time between forecast creation and the actual period that is forecasted. Hence, the forecast errors increase as forecasting goes far into the future. The accuracy measures are also affected by the detail level of forecasts. The forecast error is lower when forecasting the demand at a product group level rather than an individual SKU level.

According to Davydenko and Fildes (2016), the traditional measures are poorly affected by extreme values. In line with this, Stadtler et al. (2015) mention that MAPE is not computable if the actual quantity during a time bucket is zero. Therefore, Jonsson and Mattsson (2009) encourage demand error monitoring, which entails monitoring exceptional actual demands and removing them from negatively influencing future forecasts if it exceeds a specific factor. The extreme values might be large orders made once a year by a customer or delayed deliveries consolidated into one shipment. Furthermore, the authors introduce the concept of forecast error monitoring. Monitoring forecast errors are made by evaluating if the added mean error of forecasts over a period are within control limits. Should it exceed those limits, manual corrections have to be performed to secure an efficient forecasting process. Stadtler et al. (2015) further argue that sales and other functions tend to inflate the volumes of future orders to ensure supply availability, leading to systematically high forecasts, i.e., bias. Mean deviation (MD) can be measured to evaluate if bias is prevalent. If the MD factor is higher than zero, there is a bias in the forecast. The output from MD can be used to modify the forecast number to reduce bias.

Measuring the forecast value-added is also a part of demand planning control (Gilliand 2002; Stadter et al., 2015). Measuring forecast value-added is suitable when several steps in the forecasting process and cross-functional contributions add to the end number. The forecast accuracy measurement of the current step is subtracted from the previous step to measure the forecast value-added. If the number is positive, the step brings value to the overall forecasting process. According to Stadtler et al. (2015), this tool is beneficial when setting goals and targets for participants in the demand planning process. The authors argue that this method increases the efficiency of the demand planning process and affects the whole supply chain performance.

2.2 Maturity models

In this section, the purpose of using maturity models will be described to emphasize its usefulness. A mapping of different maturity models for demand planning will be provided, which will be the foundation for a demand planning development framework.

2.2.1 Current demand planning maturity models

Fraser, Moultrie, and Gregory (2002) described the notion of maturity as going from an initial point of development to an advanced state. Maturity models have increasingly become popular to gauge organizational performance for different processes (Khoshgoftar and Osman, 2009). These models convey explanations and pinpoint phases companies go through when developing processes (Irena Hribar Rajterič, 2010). These models aim to evaluate the current state and set goals for future aspirations on the maturity of processes.

Extant literature shows three different maturity models concerned with demand planning, see table 2.1. The maturity models have similarities and differences. The four-phase model proposed by SAS and Purdue University (2009) introduces four dimensions of maturity that can be gauged: process integration, customer integration, performance integration, and systems integration. The model's four evolutionary phases are: beginning, improving, evolving, and best practices. This maturity model emphasizes external collaboration and coordination with customers but neglects the aspect of forecasting methods.

Mentzer et al. (1999) proposed another four-stage maturity model. The model also suggests four maturity dimensions: functional integration, approach, systems, and performance measurement. The model is similar to SAS and Purdue University's model, but it features a slight variation concerning the dimension approach. The model of Mentzer et al. (1999) emphasizes internal collaboration and coordination while managing the forecasting approach by segmenting forecasting objectives.

Lastly, Vereecke et al. (2018) propose a model with six dimensions: data management, usage of forecasting methods, management of forecasting methods, performance management, the forecasting organization, and people management. This model adds to the previously mentioned models because it considers the fit between employees within the forecasting process and the skills necessary for an efficient process. Furthermore, the organizational aspect of the forecasting process is considered, highlighting the support from management and ownership structures. The model of Vereecke et al. (2018) is more comprehensive than the models described earlier. However, it does not consider evolutionary phases of demand planning, making it less suitable as guidance in developing a demand planning process.

Table 2.1: *A summary of the three found maturity frameworks concerning each design variable.*

Literature	*Information system support*	*Collaboration and coordination*	*Forecasting methods*	*Performance management*	*Skills and organisation*
SAS and Purdue University (2009) **1-4 Stage maturity model**	***System integration:*** - System autonomy - System compability externally and internally ***Customer integration:*** - Upstream focus on Supply chain planning - Real time data from customers (Point of sales)	***Procces integration:*** -Internal Collaboration -External planning collaborations -Rewards ***Customer integration:*** - Upstream focus on Supply chain planning - Real time data from customers (Point of sales)		***Performance integration:*** - Degree of corrective actions take in consideration to forecast accuracy	
Ann Vereecke, Karlien Vanderheyden, Philippe Baecke and Tom Van Steendam (2018) **Score based maturity model**	***Data management:*** - Use of external and internal data in forecasting efforts - Updating data consistently - Ownership structures ***Management of forecasting system:*** - Real time link internally between systems - Major customers integrated - Transparent and easily accessed forecast reports"	***The forecasting organisation:*** - Functional integration in forecasting process - Commitment to one number - Management support - Ownership structures and process team	***The use of forecasting methods:*** - Use of advanced statistical methods - Combining qualitative and quantitative methods - Documentation of judgements - Tailoring methods to situation	***Performance management:*** - Clearly defined accuracy metric - Tied to operative measures - Corrective measures in accordance to accuracy - Benchmarking	***People management:*** -Relevant training for forecasting personnel - Experience within team - Incentive systems
Mentzer, Bienstock and Kahn (1999) **1-4 stage maturity model**	***Systems:*** -Degree of integration between forecasting software and other internal systems - EDI linkages with major customers	***Functional integration:*** - Degree of involvement by different functions in the forecast process - Recognition of forecasting needs - Forecasting function - Feedback loops in consensus meetings	***Approach:*** - Segmentation of products and forecasts - Recognition of judgement - Top down and bottom up approaches - Understanding biases - Aligning forecasting with business plan	***Performance measurement:*** - Degree to which Accuracy is measured - Degree of which accuracy dictates corrective actions -Degree to which accuracy is tied to operational performance	

2.3 Design variables in demand planning

This study suggests five primary design variables for evaluating companies' demand planning progress, drawing from the maturity models described earlier: information systems support, collaboration, and coordination, forecasting methods, and skills.

2.3.1 Information systems support

Majchrzak and Markus (2012) define *information systems* as the interaction between tools, data, software, and procedures to enable information processing and sharing needed in specific processes. Information systems enable applying ERP applications, e.g., demand planning, financial management, and decision support. In this respect, the authors distinguish between technological affordance and constraints regarding information systems support. Technological affordance refers to the degree to which technology can fulfill the organization's needs. Technological constraints refer to the degree to which a particular technology holds back an organization from fulfilling a need.

All the maturity models described earlier recognize the need for information systems support in developing a mature demand planning process. Vereecke et al. (2018) argue that a demand planning process cannot be efficient unless a proper information system is prevalently suited for the company's situation. Information systems should allow for sharing information with other departments within the organization easily, and forecasts should easily be retrievable by parties involved in the forecasting process. Linkages with external partners can give access to data in real-time, increasing the quality of data. Going from a non-developed information system to a fully developed one entails increasing the degree of system openness internally and externally (SAS and Purdue University, 2009; Mentzer et al., 1999).

Vereecke et al. (2018) emphasize the importance of data management regarding information systems support. Historical data is input to statistical forecasting methods, and the amount of data available dictates the appropriate forecasting method. Syntetos, Babai, Boylan, Kolassa, and Nikolopoulos (2016) argue that demand and sales data are not the same. Demand data include lost sales from stock-outs, while sales data are estimations of actual demand. According to Vereecke et al. (2018), forecast accuracy depends on the freshness of data used in the calculations. Therefore, it is necessary to periodically update and adjust historical data according to the current situation and internal activities such as promotions.

Vereecke et al. (2018) bring forth the option of using external sources of data in forecasting. Davis and Mentzer (2007) introduce three different external factors that could benefit the forecasting process; the economic environment, market-specific conditions, and customer characteristics. Having a clear data ownership structure while managing external and internal data and combining it with historical demand data are prevalent in a mature demand planning process.

2.3.2 Collaboration and coordination

As demand planning is a cross-functional process, both collaboration and coordination are crucial (Mentzer et al., 1999). Crum and Palmatier (2003) argue that individual objectives of functions might counteract and decrease the overall efficiency. Individual objectives lead to the need for collaboration and coordination mechanisms within organizations and supply chains. Collaboration is when two actors/functions work jointly with more success than operating alone (Hadaya and Cassivi, 2007). Coordination represents the formal process of interacting between functions and companies (Mentzer et al., 1999). Crum and Palmatier (2003) believe that insufficient collaboration and coordination between two or more physical distribution systems lead to unnecessary costs and affect customer service. Therefore, establishing effective collaboration and coordination both internally and externally is necessary (Crum and Palmatier, 2003).

The importance of collaboration and coordination in supply chains has received considerable attention as customers are increasingly demanding and competition constantly surges. External collaboration reduces costs related to inventory and improves the performance of the supply chain, resulting in competitive advantage (Barratt, 2004). Internal collaboration is crucial as the organization must understand its processes before gaining the benefits of external collaboration.

Baratt (2004) believes companies tend to focus on external collaboration at the costs of their internal collaboration. Another common mistake is that companies often believe they are cross-functional by integrating internal functions, e.g., marketing and sales, and purchasing and manufacturing. These integrations are doomed to fail as there is a need to achieve complete internal cooperation between all relevant functions, e.g., marketing-sales-manufacturing-purchasing (Barratt, 2004). Vereecke et al. (2018) believe collaboration between functions is vital as they provide and receive input from the demand plan. When fully achieving a cross-functional organization, information is shared among the functions, joint goals are created, and a collaborative approach is imprinted in the company culture (Barratt, 2004). Transparency is a crucial enabler to create a collaborative organization; simultaneously, it reduces employee uncertainty which results in a boost of the organization's performance. Having a transparent organization also increases employees' commitment and productivity while it supports employees' fundamental understanding of their workplace (Brandes and Darai, 2017).

The organization is the foundation and primary facilitator to achieve a successful demand plan starting from top management. The number one reason for failure when implementing a demand planning process is the lack of top management support (Vereecke et al., 2019). Davis and Mentzer (2007) view sales forecasting as an organizational capability to estimate future demand by coordinating organizational resources and market knowledge. The organization should include clear ownership of processes and dedicated teams that understand their role and activities across boundaries. SAS and Purdue University (2009) argue that the organizations cooperating across functional boundaries secured higher input data quality over time, resulting in higher forecasting accuracy.

According to SAS and Purdue University (2009, p. 7), "*Improving internal collaboration for creating forecasts, pricing and promotion plans, and making mid-course corrections*" are enablers for mature demand planning processes. Vereecke et al. (2014) argue that cross-functional collaboration, together with clear ownership and dedicated teams, is a crucial enabler for an effective demand planning process. Successful internal collaboration allows for addressing organizational issues to reach consensus on forecasting processes and mitigate siloed functions (SAS and Purdue University, 2009). According to Mentzer et al. (1999), the need to focus on coordination reduces the more mature the demand planning is since communication and collaboration are done in Symbiosis.

2.3.3 Forecasting methods

The forecasting method describes the approach used to generate predictions about the forecasted object (Mentzer et al., 1999; Vereecke et al., 2018). Sanders and Ritzman (2004) identified the strengths and weaknesses of judgmental and statistical forecasts. Judgmental forecasts made by employees usually have new information about changes happening in the market environment. Such information could be competitors' moves, shifts in customer needs, and new technological changes. Judgmental forecasts tend to be biased, which could result in overstocking and poor customer service. Vereecke et al. (2018) therefore suggest documenting every judgment made to learn from the assumed impact of an event and the actual impact. Documenting judgments can generate a positive learning curve effect (Wallace and Stahl, 2008).

On the other hand, statistical forecasts have the benefits of processing large amounts of data, ensuring objectivity and modeling trends, and seasonality into the forecasts. Modeling seasonality into forecasts often requires two years of data history. The logic is that the forecasting system needs two points of data for each season to determine seasonality. However, statistical forecasts are as valid as the input data used to generate the forecasts, making the accuracy of the forecast dependent on periodic updates of data. To even out such weaknesses, the demand planning process should combine statistical and judgmental forecasting methods. Such combination is a prerequisite for a mature demand planning process (Vereecke et al., 2018: Sanders and Ritzman, 2004; Mentzer et al., 1999; SAS and Purdue University, 2009).

The demand planning process is also dependent on tailoring forecasting methods to product characteristics (Vereecke et al., 2018; Mentzer et al., 1999). Therefore, segmentation of products helps manage forecasting efforts. Mentzer et al. (1999) introduce factors that affect the forecasting efforts: point in life-cycle, the product value, and the sensitivity of customers. Other factors that dictate forecasting efforts, according to Croxton et al. (2002), are demand variability and demand volume. Low and high-volume products with low demand variability should be forecasted with statistical methods, whereas high variability and high volume require judgmental adjustments to the statistical forecasts. Lastly, high demand variability and low demand volume products are best managed with a make-to-order (MTO) manufacturing strategy, as these products are generally more challenging to forecast accurately.

Syntetos et al. (2016) argue that the demand history and forecast horizon play a role in the weight given to judgmental and statistical methods. With a longer forecast horizon, the demand history becomes more uncertain, giving more weight to judgmental forecasts. On the other hand, with a shorter forecast horizon and extensive demand history, more weight should be given to statistical approaches, and judgments should only be made in cases of exceptions. An integrated approach of both methods is to be preferred at a medium-term forecast horizon.

In a SAS and Purdue University (2009) survey, companies pinpointed forecasting new product demand as one of the most complex demand planning problems. Stadtler et al. (2015) and Syntetos et al. (2016) propose two methods that could make statistical forecasts possible for new product launches. The first method uses time series from older variants of the product or similar products to determine the life-cycle factor (Stadler et al., 2015). This factor will then be used and multiplied with average demand to get a forecast value for a certain period in the life cycle. However, Syntetos et al. (2016) argue that this method is uncertain and should be complemented with demand data as soon as possible. The other method mentioned by Stadtler et al. (2015) determines three types of phases that new products typically go through, phase-in, steady-state, and phase out. The only data needed for this method is the length of each phase and percentages of increases or decreases associated with each phase.

A sign that reflects greater maturity of demand planning processes is applying advanced forecasting methods (Vereecke et al., 2018; Mentzer et al., 1999; SAS and Purdue University, 2009). However, Vereecke et al. (2018) argue that the advanced methods do not necessarily improve forecast accuracy and must be proven to work in the company context. In line with this, Green and Armstrong (2015) state that complex methods often lead to more significant forecast errors due to practitioners using it as a black box and not understanding the methods.

To conclude this section, mature demand planning processes use a mix of forecasting methods depending on the situation (e.g., segmentation), opt for advanced methods if proven to work, and have a forecasting strategy for new product launches.

2.3.4 Performance management

Performance management in demand planning entails measuring and monitoring the quality of the demand planning process (Vereecke et al., 2018; Mentzer et al., 1999; SAS and Purdue University, 2009). The primary metric used for measuring the process is forecast accuracy. According to Vereecke et al. (2018), linking this metric with the performance of the overall business is valuable. The forecast accuracy metrics should have links with internal and external measurements, such as internal accuracy goals and customer service levels. Performance management further includes monitoring exceptional demand values, which must be adjusted and should monitor biases in forecasts. However, performance management should not serve in solitude but as an indicator for demand planning process improvement (Vereecke et al., 2018). Davis and Mentzer (2007) argue that control limits on forecast accuracy represent a way of highlighting the need for corrective actions in the process. Not having a performance measurement leads to slower improvement of the forecasting process. The concept of forecast value addition can aid in setting goals for each activity in the demand planning process (Stadtler et al., 2015).

In short, a mature demand planning process applies performance measurements as indicators for process improvement, and the related metrics align with business performance (Vereecke et al., 2018; Mentzer et al., 1999; SAS and Purdue University, 2009).

2.3.5 Skills

The demand planning process relies on forecasting. Forecasting requires analytical skills that might be obvious but often lacks the capability for organizations. Vereecke et al. (2019) did a survey showing that forecasters generally did not have sufficient knowledge within statistics or understanding of forecasting methods' foundation. Combining statistical forecasts with judgmental forecasts requires understanding the market trends. Therefore, to acquire the skills that support forecasting with high accuracy, individuals must be trained and educated. Vereecke et al. (2019) also emphasize the importance of focusing on technical skills as it is equally important to understand the organization’s market. Klein (2003) claims that the experience when forecasting is a crucial determinant of success. Davis and Mentzer (2007) describe how learning and gaining experience are cyclical processes obtained by interacting with their environments and are core phenomena for organizational learning. People also need to have communication skills as demand planning is a multi-disciplinary process. Accordingly, organizations facilitate communications and support individuals’ and teams’ possibilities to develop communication skills.

2.4 Proposed demand planning development framework

The proposed demand planning development framework draws inferences from three different maturity models, see table 2.2. The proposed model is structured around five design variables: information systems support, collaboration and coordination, forecasting methods, performance management, and skills. Each design variable has four evolutionary phases except skills, which has three. Mapping what goes into each evolutionary phase was influenced by Meltzer et al. (1999) and SAS and Purdue University (2009), and Vereecke et al. (2019).

Table 2.2: *Proposed framework influenced by Meltzer et al. (1999) and SAS and Purdue University (2009) and Vereecke et al. (2018).*

	Step 1	Step 2	Step 3	Step 4
Information systems support	* Insufficient historical data stored * Data not shared externally nor internally * Data not updated periodically * Insufficient understanding on internal as well as external impacts on demand data * No integration between systems used at different departments * Few employees understand systems * Manual- and simple systems	* Data stored but not managed * Impacts from internal factors complement demand data * Impacts of external factors do not complement demand data * Data updated in a reactive manner * Established system integration between departments internally * Systematically generated reports periodically * Visible performance available in generated reports	* Data stored and stuctured * Understanding external and internal factors affecting demand data and complement it accordingly * Data shared internally and externally to drive planning * Data updated periodically * Common database used by involved functions in the forecasting process * Modern and flexible interface * Advanced planning system * Hierarchial planning possible and range of statistical methods available"	* Data stored and stuctured * Understanding external and internal factors affecting demand data and complement it accordingly * Data shared internally and externally to drive planning * Data updated periodically * Demand and forecast monitoring indicating data adjustments * Clear ownership model and rule-set for data adjustments * EDI connection to major external stakeholders (e.g suppliers and customers) * Easily modified system * Online customer collaboration
Collaboration and coordination	* Disconnect between functions * Forecasting efforts made in silos * No accountability for forecast accuracy	* Collaboration and coordination between sales, marketing, operations * Forecasting responsibility dedicated to one functional area * Consensus meetings without real consenus, decisions on final number often made by either marketing or operations	* Cross-functional integrated collaboration and coordination * Reaching real consensus in the consensus meetings * Employee dedicated to improving forecast process * Some customer involvement in forecasting effort	* Fully integrated functional collaboration * Needs from different functions recognized in forecasting efforts * Demand planning process integrated with S&OP * Efforts in planning extend externally with major customers * Forecasting as an own department
Forecasting methods	* Judgemental forecasts made in silos * Reactive to orders * No data to base statistical forecasts on * All products forecasted the same * Business plan drives forecasting	* Simple statistical forecasting methods used * Judgemental forecasting taking internal and external situations into consideration. Forecasts still not combined. * Identifying product demand patterns * Recognition of forecasting but business plan is still the priority	* Judgemental and statistical forecasts are combined with input from several functions to be discussed in a consensus meeting * Forecasts tailored to products (e.g Seasonality vs. non-seasonality) * Products indentified that do not need forecasting (e.g Kanban, MTO, dependent demand) * Documenting judgements made for learning purposes * Method for product categorization in regards to accuracy * Forecasting drives business plan	* Use of advanced statistical methods if it is shown to improve accuracy * Using forcasting methods that have been proven to be benificial for the company context * Judgemental and statistical forecasts are combined with input from several functions to be discussed in a consensus meeting * Full segmentation of products for forecasting * Judgements systematically logged * Different forecasting methods used depending on situation * Synergies between forcasting and business plan
Performance management	* No use of accuracy measurement * The performance of the forecasting process is not evaluated	* Forecast error used to measure accuracy * Accuracy measure not tied to operational KPIs (Inventory turnover, service levels)	* Forecast accuracy linked with supply chain impact * Accuracy tied to operational KPIs * Errors made visible graphically * Process steps measured indivudally on value added to the final forecast	* Uses forecast errors as indicator for problems that need solving * Accuracy tied to business performance * Measuring economic value added of process * Measuring forecast value add to evaluate each step of the forecast process * Visibility through graphs
Skills	* No training * Unexperienced personnel * Subpar skills in analytics and communications * Lacking knowledge about industry	* On the job training * Access to external training, however not mandatory * Increased knowledge of market and analytics * Communication somewhat modified depending on function speaking to	* On going training from internal and external sources * Well-developed knowledge both about industry as well as forecasting methods * Communication tailored to function, speaking the same language	

2.5 Contextual variables in demand planning

Vereecke et al. (2018), Mentzer et al. (1999), and SAS and Purdue University (2009) set forth design variables connected with evolutionary phases for mapping the current development of demand planning processes. However, the authors have neglected the impact of contextual variables and how they might either inhibit or enhance the possibilities for advancement through evolutionary phases.

Several generic best practices for demand planning processes aim at accurately foreseeing future demand. However, the context in which organizations reside affects the path to follow in demand planning development. Jonsson and Kristensen (2018) introduces several contextual variables affecting the S&OP process design and, therefore, indirectly the demand planning process: industry type, dynamic and detail complexity, and firm size. The industry type dictates how different products- and market-related factors change the design of demand planning processes. For example, with perishable goods, the food industry needs to have a specific configuration of the demand planning process to meet the risk of obsolete products.

Dynamic and detailed complexity are also contextual variables in the demand planning process. Dynamic complexity regards uncertainty of demand and might necessitate scenario planning to mitigate risks of disruptions. Also, having close coordination with customers represented by point-of-sale data mitigates demand uncertainty during product launches.

Detail complexity refers to the complexity of the supply chain, e.g., the number of process steps, sales and marketing units, and levels in the bill of material. Jonsson and Kristenssen (2018) argue that higher detail complexity increases the need for coordination between departments and units, such as information systems support. Another contextual variable proposed by Jonsson and Kristensen (2018) is firm size. The findings showed that large companies gain more advantages of having a more integrated demand planning process. Furthermore, Vereecke et al. (2018) found a correlation between firm size and maturity in demand planning processes. The authors attribute these findings to larger companies having the power and resources to enable a formal demand planning process internally and externally.

To conclude, companies face similar problems but must approach them differently due to contextual variables. Contextual variables are present for all organizations, so the demand planning process should be designed accordingly.

3. Methodology

This chapter describes the thesis research design, the selected case, the data collection process, the data analysis process, and the approaches used to ensure reliability and validity.

3.1 Research design

This research adopted a case-study design. Case studies are frequently used in operations management research (Voss, Tsikriktsis, and Frohlich 2002). What differentiates the case study design from other methods is that it allows the researchers to investigate a specific case and gain in-depth knowledge about a unique situation (Bryman and Bell, 2011).

The research adopted a single-case study design as there was limited access to available research on the topic. Research related to demand planning development is scarce in general, even more for the development of demand planning in the early phases of business growth. There is existing research focusing on demand planning maturity, but it neglects the potential impact contextual variables have early in the development. The limitedness of research on the topic made a single case study suitable as it allows the authors to study the phenomenon in practice and cover greater breadth and depths of the studied object (Yin, 2017). The detailed investigation of demand planning development required data inquiries from past, current, and planned process states. Furthermore, demand planning is a complex cross-functional process where a lot of information processing occurs, requiring data-gathering from several data points within one organization. Demand planning development in early phases of business growth lacks research, making a single case study optimal, as it allows analyzing an unexplored situation and relating it to theory.

Bryman and Bell (2011) describe the possibility of using both qualitative and quantitative methods, showing that combining both types is beneficial in some cases. They state that historically, qualitative methods have been more beneficial when examining unexplored phenomena. Quantitative research needs considerable maturity and established frameworks for suggested relationships that can be tested as hypotheses, which is missing in this research case. Instead, Gioia, Corley, and Hamilton (2012) recommend using a qualitative approach when making sense of organizations and gaining a more profound knowledge of organizational dynamics.

Since this study focuses on demand planning development in early phases of business growth and how contextual variables can affect development, a neglected research field, an inductive qualitative research design is preferable. The inductive qualitative research design is beneficial when the study must sensitize concepts to approach the social context (Flick, 2018). This study synthesized three conceptual maturity frameworks to approach the company context. The empirical findings from the case study, i.e., experienced contextual variables, were later with logical links and previous theories connected to the framework.

3.2 Case description

Azelio was founded in 2008, and its ambition is to change the future of solar energy (Azelio AB, 2021). The company follows a long-term plan focusing on industrializing and commercializing its solution (Azelio AB, 2019). The expectation is to have series production up and running by the end of 2021 and have a positive cash flow in 2022. Therefore, Azelio is about to design and implement an S&OP process that includes demand planning.

Azelio has a documented S&OP process to balance customer demand with supply capacity when series production starts in 2021, Q3. The demand planning at Azelio is currently in the early phases of development. Forecasting is based on judgmental forecasts due to lacking sales history that enables quantitative forecasting. Planners and market analysts generate those judgmental forecasts drawing on data gathered from sales quotes, orders, and external factors. The result is a constrained budgeted forecast produced by upper management the organization follows. Azelio seeks alternatives to proceed from the demand planning current-state to a future-state that helps effectively and efficiently increase the planning accuracy given a few contextual variables: e.g., data availability, demand patterns, and organizational factors. The situation of Azelio thus fits well with this study's research questions.

3.3 Data collection

A literature study was conducted to identify state-of-the-art insights concerning the context impact on the demand planning process design. An initial literature review to understand the demand planning process and best practices was done by covering topics such as demand planning in S&OP, demand planning maturity, and contextual variables in demand planning was performed. In the initial review, subcategories of demand planning were reviewed to understand the demand planning process. The reviewed subcategories were information systems support, forecasting methods, collaboration and coordination, performance management, and skills. The subcategories were inspired by three maturity frameworks for demand planning, gathered in the initial review. According to Snyder (2019), having a systematic approach is essential, as a practical literature study can be used for theory development. The sources read in the literature study were categorized and summarized in Excel as a reference to the literature study. Furthermore, by incorporating different perspectives from articles, the author argues that research will be more impactful and relevant. Search engines that were used when gathering data are Chalmers library and Google Scholar. A combination of keywords was used for the search: demand planning, S&OP, demand planning maturity, and contextual variables in demand planning. Citations were used as a benchmark to evaluate the relevance and strength of the sources.

The standard methods for qualitative data collection are interviews, focus groups, secondary data like archival documents, and participant observation (Bryman and Bell, 2011). Interviews are the most common method for collecting primary data since they are relatively flexible. Interviews can be unstructured and semi-structured (Flick, 2018). The unstructured interview approach may include a start question, and from there, the interviewer will steer the conversation towards interesting paths, similar to a conversation. When it comes to semi-structured interviews, the interviewer has prepared questions to cover different topics, often called an interview guide. This research adopted both approaches, see figure 3.1 for the research workflow.

The authors developed two interview guides for the semi-structured events: one for the first interview round, see Appendix A, and one for the second round, see Appendix B. The questions were formulated drawing on literature concerning demand planning and the constructs of the conceptual framework, see table 2.2. The questions were guiding, and the interviewees replied somewhat freely. Therefore, the interviewer needed to pose new questions concerning the revealed aspects during the interview. Although the unstructured and semi-structured methods are flexible, success relies on how the interviewee understands and describes the questions' topics and how the interviewer manages and adapts him-/herself to the situation.

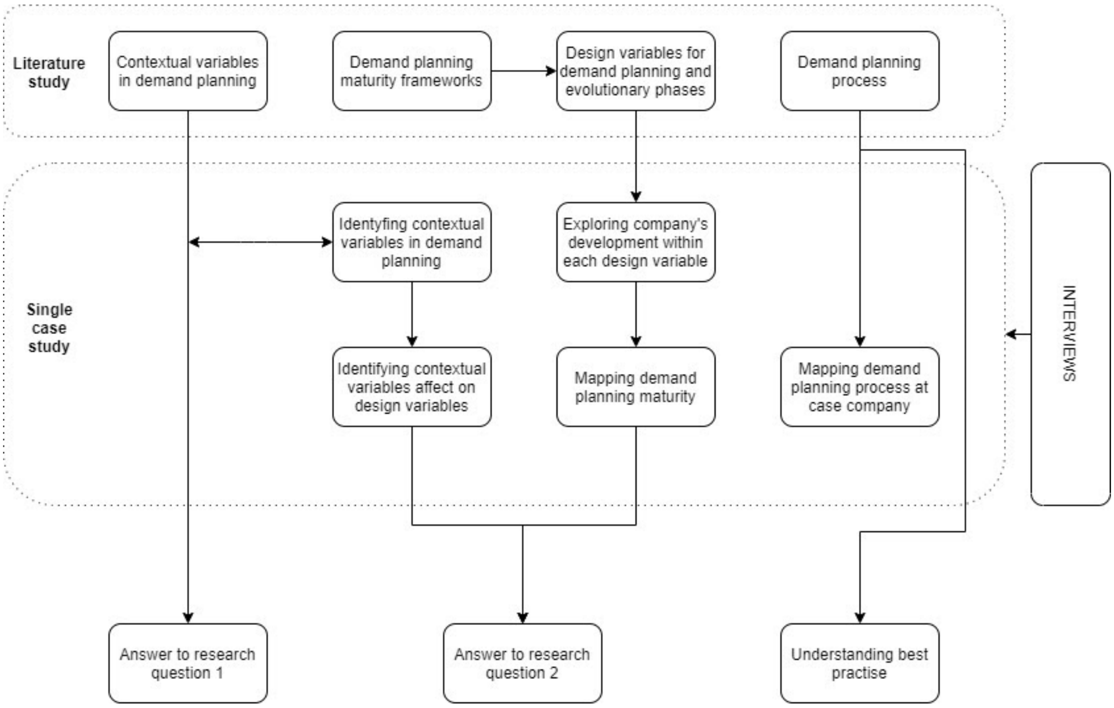

Figure 3.1*: Research workflow.*

The interviews were conducted via Teams due to Covid-19 restrictions. The unstructured approach was used in meetings with the supervisors from both Azelio and Chalmers. The semi-structured approach was used for gathering data from the selected informants at Azelio to understand the contextual variables affecting the company.

In total, ten interviews were conducted with seven different roles in the company, see table 3.1. When determining which stakeholders to interact with, our supervisor from Azelio, who is a senior supply chain specialist, supported us by choosing whom to interview. It was essential in this study to interview different functions within Azelio as demand planning is a cross-functional process, and inputs from different functions were crucial. Since the interviews were semi-structured, both closed and open questions were asked. A general set of questions was created and used for the interviews but modified depending on the interviewees' specialty. Since all interviewees were asked similar questions, overlap could be seen in the answers, establishing triangulation. The first round of interviews was focused on obtaining data regarding the current demand planning development. The data gathered was used to map Azelio's development within each design variable. During the first round of interviews, contextual variables were also identified that affect maturity development within each design variable. The first round of interviews resulted in information that answered RQ1 and information necessary to proceed with RQ2. The second round of interviews focused on the identified contextual variables affecting Azelios' demand planning and what prerequisites required to advance within each design variable, therefore giving information necessary to answer RQ2.

Table 3.1: *Participants in the interviews.*

Interviewees	**Primary responsibility**	**No. x length of interviews in minutes**
Director of Supply Chain Management	Managing and overseeing the Supply chain department (S&OP-owner)	2 x 60 min
VP operations	Responsible for the company's operations	1 x 30 min
Sales & Strategy manager for Business development	Managing sales department and business development	2 x 60 min
Senior Manufacturing Engineer	Responsible for the implementation of the manufacturing plant in Uddevalla and supporting manufacturing partners	1 x 60 min
ERP System Specialist (Demand Planning)	Responsible for information systems development	1 x 60 min
Senior Supply Chain Specialist	Responsible for designing supply chain related processes	2 x 60 min
Manager Product Installations	Responsible for management of resources and relationships on installations sites	1 x 60 min

Data collection in this research also benefited from secondary data. According to Bryman and Bell (2011), secondary data refers to the data made readily available for the researchers by someone else. Researchers use secondary data to save cost and time benefits as data can be collected from databases. These datasets are often up to date and of high quality, which positively affects research. Secondary data may also help apply triangulation, which increases the findings' validity (Sousa and Voss, 2008).

Azelio did also provide internal documents. A simplified figure of Azelio's supply chain and documentation of the wanted demand planning process was provided. The supply chain figure gave insight into the extra detail complexity experienced by Azelio, with an installation phase that affects the demand planning design. The documentation of the wanted demand planning process showed what Azelio was aiming for and made it easier to relate to the current situation of the process. These documents created a further understanding of their organization and the context of the company.

3.4 Qualitative data analysis

A method for analyzing qualitative data is to use Grounded theory that is based on coding answers from interviews and facilitating comparison of data. The method used in this study is built on grounded theory and based on an article published by Gioia et al. (2013).

Gioia et al. (2013) propose organizing the data analysis into two categorizations, first-order, and second-order analysis, approaching the qualitative data analysis in a structured way. In the first-order analysis, the analysis is done on a broader level where many new categories emerge from the interviews. The next part was to identify similarities and differences between the emerging categories. An Excel file was established to identify similarities and differences between emerged categories from the interviews in this study, with concepts on the y-axis and participants on the x-axis, see table 3.2. The table visualized the participants' answers and made comparisons of interviews easier in the analysis. The emerging categories were clustered into concepts that can be seen in the table below.

Table 3.2: *Model used to summarize the gathered data during interviews.*

	VP Operations	Director of Supply Chain Management	Finance Controller	Sales & Strategy manager for Business development	Senior Manufacturing Engineer	ERP System Specialist (Demand Planning)	Senior Supply Chain Specialist	Manager Product Installations
Introduction								
Business model								
Demand planning								
Information system support								
Forecasting methods								
Performance management								
Collaboration and coordination								
Skills and organization								

In the second-order analysis, theoretical models and frameworks are investigated to see if the phenomena can be explained with existing literature (Gioia et al., 2013). A maturity framework was developed to explore the development within design variables related to the demand planning process. The three articles used to create the maturity framework were: Vereecke et al. (2018), Mentzer et al. (1999), and SAS and Purdue University (2009). The articles' guidelines were combined in a new framework to create a foundation of what characteristics are needed to advance through the evolutionary phases in the maturity framework. Trying to identify the challenges of demand planning in early business growth was difficult due to the lack of literature covering this topic. Therefore, literature exploring the context in S&OP was used in conjunction with the second round of interviews focused on contextual variables, connecting with logical links, the two subjects.

When the categorizations and concepts had been identified, it was possible to aggregate dimensions and distinguish two variables affecting demand planning development in the early stages of business growth, see figure 3.2. The study distinguished two types of variables affecting demand planning, design- and contextual variables, that the analysis further centered around to answer RQ1-2. *Design variables* were identified in the literature study, and these are defined as variables organizations can freely affect regarding process design. *Contextual variables* are defined as variables that organizations must relate to and design the process accordingly. Therefore, a contextual variable indirectly affects demand planning as it affects the organization's design of processes.

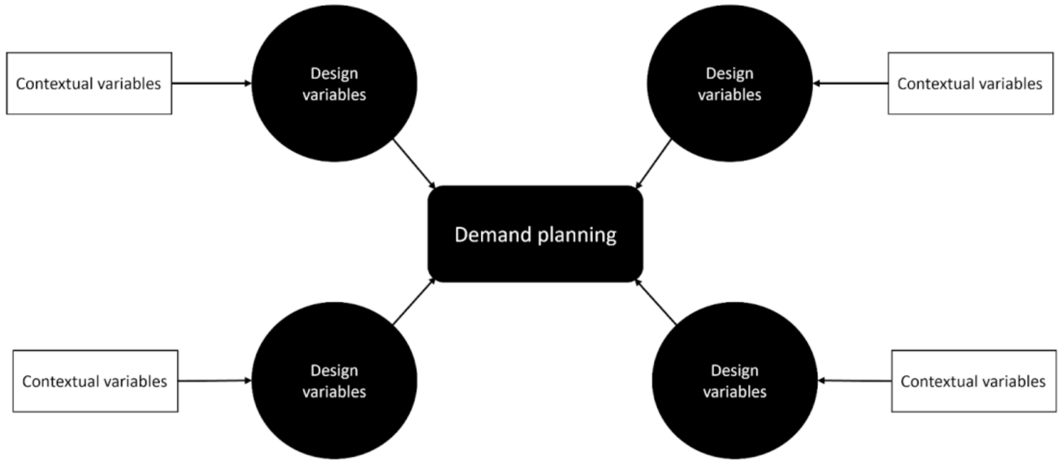

Figure 3.2*: Illustration of how contextual variables affects the design variables and how the design variables affect demand planning.*

3.5 Research quality

Shenton (2004) proposes a criterion for assessing the quality of the research: trustworthiness. *Trustworthiness* consists of four criteria: credibility, transferability, dependability, and confirmability. Credibility refers to what degree the researchers have understood the social world they have studied. There are two methods to ensure credibility: respondent validation and triangulation. Respondent validation entails that the researchers send the findings to participants from the studied entity to ensure they correspond well with the participants' experience. The authors in this research have done respondent validation through weekly meetings with the supervisor at Azelio. Triangulation entails the usage of different perspectives from data sources to arrive at the same result. Triangulation was applied through cross-checking data from interviews with personnel at different levels of the company and data gathered from the internal documents.

Another criterion is transferability. Transferability refers to what degree the findings from the qualitative research are applicable and valuable in other contexts. Bryman and Bell (2011) suggest producing detailed descriptions concerning the study subject to enable the gauging of transferability for other researchers. Accordingly, the authors developed detailed descriptions of the empirical findings through several interviews with the supply chain specialist and market analysts at Azelio. Furthermore, the authors used internal documents to enrich the empirical findings with informative insights.

The third criterion is dependability, which refers to researchers having an auditing approach. Dependability assumes that complete documentation is done throughout the whole research process, for example, problem formulation, fieldwork notes, and interview transcripts. Peers could act as auditors during the whole research process to secure that proper methods have been used (Bryman and Bell, 2011). In this research, the supervisors from Azelio and Chalmers were auditors that regularly reviewed trustworthiness. Although auditors are helpful, increasing dependability through auditors is time demanding. Therefore, this method is not widely prevalent (Bryman and Bell, 2011). However, using audits for a master thesis is suitable since supervisors are appointed as gatekeepers to control the trustworthiness of the thesis.

Confirmability refers to the extent to which the research findings could be confirmed by other researchers (Korstjens and Moser, 2018). Increasing confirmability implies that the assumptions and interpretations leading to the findings are derived from the empirical data clearly, not just figments of the researcher's imagination. This criterion can be fulfilled if the researchers show that the findings and analysis are not affected by personal values, and the theoretical frameworks are not manipulated to fit the researcher's arguments. Establishing confirmability for this research was done using auditors from both Azelio and Chalmers, ensuring different views.

4. Company background

This chapter describes the company in the case study. The company's business and supply chain are further explained.

4.1 Company description

Azelio was founded in 2008, and its ambition is to change the future of solar energy (Azelio AB, 2021a). By large-sized investments for developing technology and buying rights from a German company, Azelio developed a solution based on the Stirling engine technology (Azelio AB, 2021b). In 2018, Azelio presented a ground-breaking thermal storage solution divided into two products: the Stirling engine and energy storage (Azelio, 2021c). The operation span of Azelio goes from advanced engineering and R&D to production. The production focuses on assembling both the Stirling engine and the storage unit, but Azelio outsources the energy storage unit to the supply chain.

Azelio has its headquarters in Gothenburg, the development center in Åmål, and the production plant in Uddevalla (Azelio, 2021d). The production plant design follows lean manufacturing principles, which also permeate through the entire organization. Azelio also has an office in both Beijing and Madrid and is currently setting up an office in Morocco to create a presence worldwide to establish strategic partnerships.

Azelio follows a long-term plan focusing on industrializing and commercializing its solution (Azelio AB, 2019). The company has already started the commercialization solution with a verification project in Morocco 2019, and the goal is to start series production in the third quarter (Q3) of 2021. The expectation is to have series production up and running by the end of 2021 and have a positive cash flow in 2022. Therefore, Azelio is about to design and implement an S&OP process that includes demand planning.

4.2 The business of Azelio

The world is facing a significant challenge in energy consumption and obtaining the correct type of energy at the right cost is crucial for global economic growth. Thanks to technology development and increased competitiveness, the renewable energy market is fast-growing, as solutions have become more cost-effective. Azelio wants to contribute by replacing fossil fuels with more green energy at a competitive cost (Azelio, 2021e). Grids must also rely on renewable sources of energy to make this transition fully green. The renewable energy sources contain a growing mix of elements that drives energy storage demand, similar to Azelio's solution.

In many places worldwide, lacking access to grids, wind and solar energy are abundant but not utilized (Azelio, 2021e). Today, many people either live without grids or in areas where grids exist but are unstable. Therefore, there is a need to have decentralized solutions, providing electricity in small local grids for which Azelio's solution is suitable. However, solutions today are primarily dependent on intermittent production, namely, that the sun must shine or the wind to blow in order for it to function. These solutions cause reliability issues, and non-renewable energy sources thus need to serve as a stable energy source. Azelio aims to resolve this reliability issue using its ground-breaking solution to store energy from both wind and sun while making it available any time of the day.

Azelio targets geographies that have excellent solar conditions (Azelio, 2021e). Such conditions apply to many areas that have grid shortages and unstable power supply. All continents have shown interest in Azelio's solution; however, the company initially targets the Middle East and North Africa (MENA). The solution of Azelio is suitable for various sectors such as mining, agriculture, resorts, communities, and telecommunications. Typical customers of Azelio are project builders located in regions where conditions are beneficial for concentrated solar power.

4.3 The solution

Azelio offers a solution to store and supply clean energy whenever needed. The solution is called TES.POD and consists of two central units: a Stirling engine and thermal energy storage, see figure 4.1. The Stirling engine is a 200-year-old invention that can generate electricity by converting thermal energy into a mechanical movement (Azelio AB, 2021f). Thermal energy storage (TES) represents the solution heart. TES stores energy by conserving heat and transforms the energy into electricity after storage (Azelio AB, 2021g).

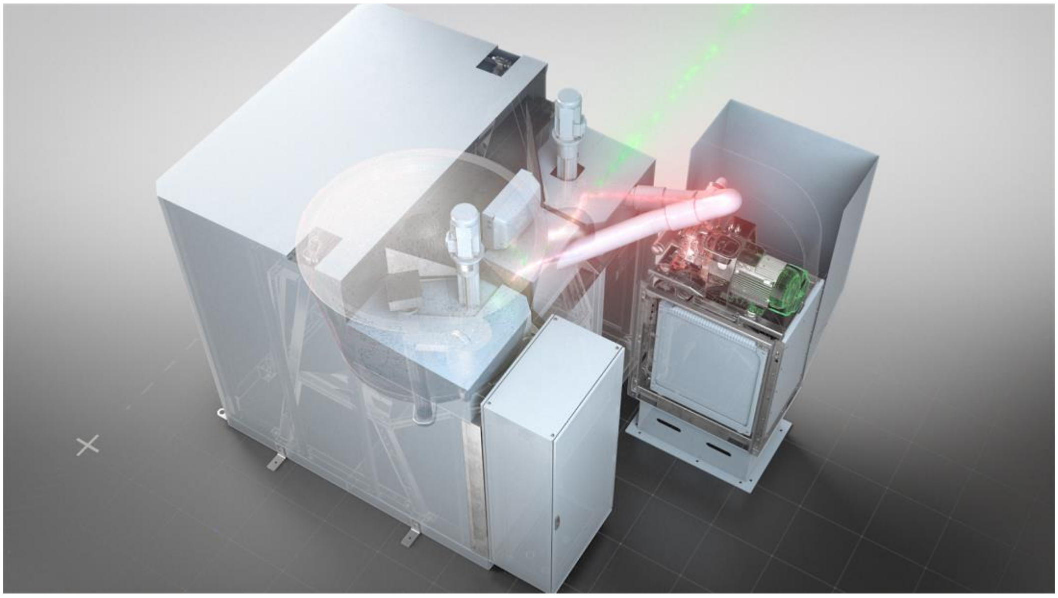

Figure 4.1: *TES.POD.* Reprinted from Image archive [image] by Azelio AB, 2021, Retrieved from https://www.azelio.com/media/image-archive/

The solution generates energy through a process that has several steps (Azelio AB, 2021f). The TES charges with solar energy, wind power, or electricity from solar photovoltaics (PV) using heat treatment. Then, an aluminum alloy is heated up to a phase-changing state and can store energy for a long time. After that, the thermal energy is transferred from the TES to the Stirling engine using a heat transfer fluid. The Stirling engine produces electricity on demand by a generator. The solution can store energy for up to 13 hours, deliver heat up to 55-65 degrees celsius, and perform in harsh climates such as snow- and sandstorms. The solution can achieve an output efficiency of up to 90% and can be used to supply, for example, mines, factories, small communities, and agriculture with electricity 24/7.

4.4 Azelio's supply chain

To get a simplified overview of the current Supply chain of Azelio, see figure 4.2. The philosophy used by Azelio in building the supply chain network is to source material from suppliers located nearby, i.e., spread throughout Europe. However, the company needs to source some components from outside Europe due to resource scarcity.

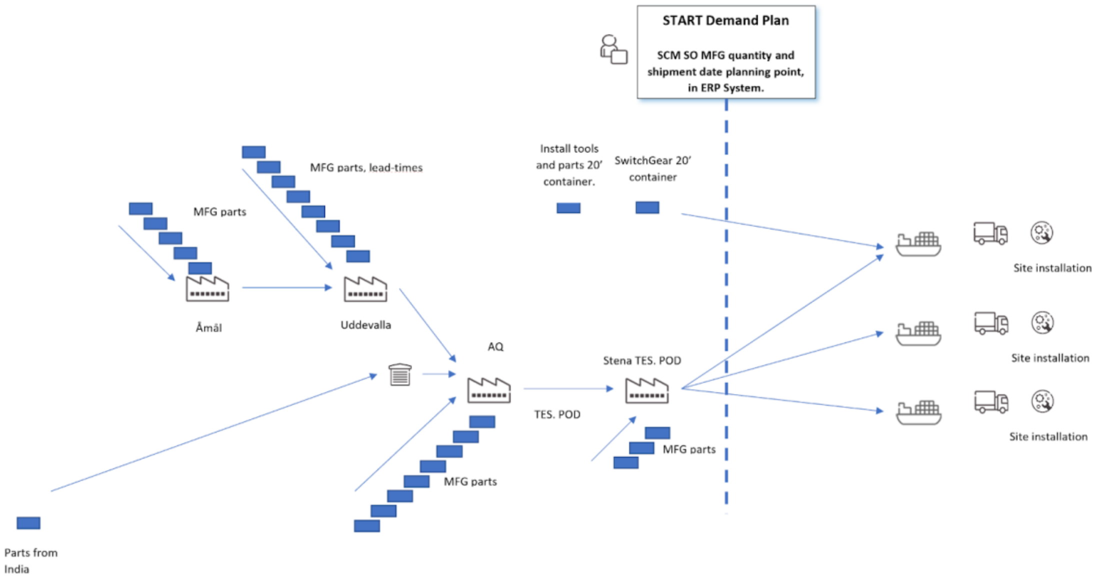

Figure 4.2: *Azelio supply chain network map.*

In Åmål, Azelio has a production site producing a part of the engine, which is the first step in the chain. The engine is sent to Uddevalla for assembling with sourced materials into a complete Stirling engine at Azelio's high volume facility. The complete Stirling engine and critical parts from the source country outside the EU are sent to the industrial partner, called AQ Enclosure Systems. The industrial partner, AQ Enclosure Systems, makes the storage unit, which is later shipped as TES.POD to another partner, Stena. At Stena, the TES.POD is filled with an aluminum alloy. Stena then ships the TES.PODS together with installation tools and parts by ship and then lorry to the installation sites see figure 4.3 for an example. Currently, installation for customers is managed by Azelio. In some cases, the company needs site construction before the unit installation phase. Azelio plans to dedicate an aftermarket function that provides on-site maintenance service to the delivered TES.PODs.

Figure 4.3: *Azelio storage facility*. Reprinted from Image archive [image], by Azelio AB, 2021, Retrieved from https://www.azelio.com/media/image-archive/

The plans are based on sales orders, including split shipment and shipping dates. The demand planning point is set after shipment from Stena, and the ERP system calculates backward, including purchasing and manufacturing lead times to meet set sales orders. The products are sold in clusters of 40, meaning that customers must commit to multiples of 40 TES.PODS when buying Azelio's products.

5. Findings

In this chapter, an explanation is given of Azelios' demand planning process, and a description of Azelios' current situation in terms of design- and contextual variables is specified. Azelios' development is positioned within the demand planning development framework, and a guideline for further advancement is identified.

5.1 Demand planning at Azelio

The demand planning is under development, and documentation of the process has been established. Azelio has opted for a provisional demand planning process in the early phases, and both processes are described in this sub-chapter.

5.1.1 Documented process

Azelio has established the wanted demand planning process documentation, see figure 5.1. Azelio's documented demand planning process is an iterative four-step process. The frequency of the process is set to be done once a month. Given that there is one product, aggregation is based on geographies, consolidated into regions and areas. It begins with input from "supply planning," followed by "gather sales/supply information," which leads to an approval step where an S&OP board approves or disapproves the demand plan. If the board does not approve the plan, the process reiterates, and more sales and supply information is gathered. The outcome of the process is an approval of sales orders, demand forecast, and inventory levels.

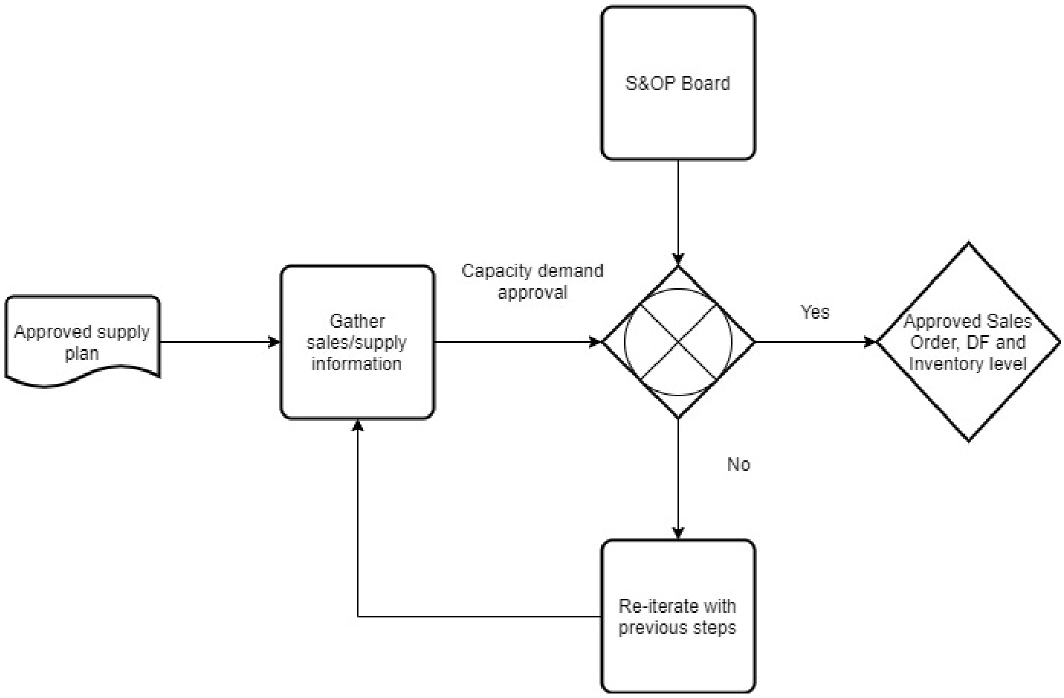

Figure 5.1: *The documented demand planning process of Azelio.*

The input for the demand planning process is supply planning which considers several supply parameters. In this step, an analysis of parameters such as supplier capacity and forecast deviation data is executed. The demand planners/MRP evaluate long-term material requirements and calculate purchase delivery dates for long lead-time items. The supply planning further entails analysis and calculations of inventory control support and long-term future warehouse requirements. Lastly, the supply planning step considers and sets a strategy for inventory management. Setting inventory strategies constitutes setting strategies for safety stocks, reorder points, multiple order quantities, and multiples level calculation and review.

The *first step* is gathering sales and supply information. The step entails, as the name implies, gathering the sales and supply forecasts. The information from the forecasts is aggregated and analyzed to derive in a “demand forecast.” The initial demand forecast will be discussed in a “coordination meeting” where the S&OP board discusses specific topics.

The *second step* is the coordination meeting and is the part where final decisions are formed. The chairperson in this meeting is the supply chain manager, and the decision-makers are upper management, together making the S&OP-board. The coordination meeting entails approval or disapproval of, sales forecast, supply forecast and demand forecast, and inventory levels. In this step, decisions are also made regarding allocation of capacity and increasing or decreasing capacity. Topics discussed during the meeting are safety stocks, reorder points and multiple order quantities. The demand planning and the supply planning consensus meeting are consolidated as information to be discussed at a coordination meeting with the S&OP-board.

The outcome of the process is approved sales orders, demand forecasts, and inventory levels. The filtered data will then be communicated to supply chain actors. Actors planned to be informed are suppliers and production facilities, which is executed to drive capacity dimensioning.

5.1.2 Current state

The current state of demand planning at Azelio is set up differently from the documented process, see figure 5.2. There is an ongoing business and strategy review done by upper management, where one of the outcomes is a budgeted forecast based on assumptions on possible market percentage. The planning horizon is a rolling six-month demand forecast for sub-suppliers, and for significant capacity investments and resource planning, the horizon is 18 months.

Figure 5.2: *Current demand planning process at Azelio.*

The budgeted forecast is later input for the supply chain specialist at Azelio, who adjusts the forecast depending on the design process and how complete the product is. Next step, without having an S&OP-meeting, the supply chain specialist looks at the capacity available from certain suppliers and analyzes the lead times to evaluate if production can meet the demand. Today, the forecast planning is against quantity, and a shipping date and the forecasts are constrained by capacity. The constrained demand forecasts are dedicated to the fact that the only available information is the budgeted forecast and the production constraints during the ramp-up phase. Based on the interviewee's experience, this is a common problem for start-ups.

The inputs and outputs from this process are used to give feedback to suppliers and production sites. Feedback is conveyed to the Åmål plant, which produces one part of the engine, the Uddevalla plant, which assembles the complete engine and partners, producing the storage unit. Actors that are given feedback are critical suppliers that supply critical components. This process aims to take the budgeted forecast and analyze it, e.g., analyzing what should be produced at what date. Information is later shared with the sales organization, which is an indication to start selling products. Pre-S&OP and S&OP are the consensus meetings; however, in the current situation made in an ad hoc manner, instead of the wanted routinely once per month. Currently, the decision on the final number is a group budgeted forecast made by top management. The main struggle mentioned by the interviewee is change management and getting the involved functions to understand the process.

5.2 Placement in the maturity framework

This section assesses Azelios' current situation regarding design variables and the position on the maturity scale. Azelio has low demand planning maturity levels maturity framework across all design variables, see figure 5.3.

	Step 1	Step 2	Step 3	Step 4
Information systems support	* Insufficient historical data stored * Data not shared externally nor internally * Data not updated periodically * Insufficient understanding on internal as well as external impacts on demand data * No integration between systems used at different departments * Few employees understand systems * Manual- and simple systems	* Data stored but not managed * Impacts from internal factors complement demand data * Impacts of external factors do not complement demand data * Data updated in a reactive manner * Established system integration between departments internally * Systematically generated reports periodically * Visible performance available in generated reports	* Data stored and stuctured * Understanding external and internal factors affecting demand data and complement it accordingly * Data shared internally and externally to drive planning * Data updated periodically * Common database used by involved functions in the forecasting process * Modern and flexible interface * Advanced planning system * Hierarchial planning possible and range of statistical methods available"	* Data stored and stuctured * Understanding external and internal factors affecting demand data and complement it accordingly * Data shared internally and externally to drive planning * Data updated periodically * Demand and forecast monitoring indicating data adjustments * Clear ownership model and rule-set for data adjustments * EDI connection to major external stakeholders (e.g suppliers and customers) * Easily modified system * Online customer collaboration
Collaboration and coordination	* Disconnect between functions * Forecasting efforts made in silos * No accountability for forecast accuracy	* Collaboration and coordination between sales, marketing, operations * Forecasting responsibility dedicated to one functional area * Consensus meetings without real consenus, decisions on final number often made by either marketing or operations	* Cross-functional integrated collaboration and coordination * Reaching real consensus in the consensus meetings * Employee dedicated to improving forecast process * Some customer involvement in forecasting effort	* Fully integrated functional collaboration * Needs from different functions recognized in forecasting efforts * Demand planning process integrated with S&OP * Efforts in planning extend externally with major customers * Forecasting as an own department
Forecasting methods	* Judgemental forecasts made in silos * Reactive to orders * No data to base statistical forecasts on * All products forecasted the same * Business plan drives forecasting	* Simple statistical forecasting methods used * Judgemental forecasting taking internal and external situations into consideration. Forecasts still not combined. * Identifying product demand patterns * Recognition of forecasting but business plan is still the priority	* Judgemental and statistical forecasts are combined with input from several functions to be discussed in a consensus meeting * Forecasts tailored to products (e.g Seasonality vs. non-seasonality) * Products indentified that do not need forecasting (e.g Kanban, MTO, dependent demand) * Documenting judgements made for learning purposes * Method for product categorization in regards to accuracy * Forecasting drives business plan	* Use of advanced statistical methods if it is shown to improve accuracy * Using forcasting methods that have been proven to be benificial for the company context * Judgemental and statistical forecasts are combined with input from several functions to be discussed in a consensus meeting * Full segmentation of products for forecasting * Judgements systematically logged * Different forecasting methods used depending on situation * Synergies between forcasting and business plan
Performance management	* No use of accuracy measurement * The performance of the forecasting process is not evaluated	* Forecast error used to measure accuracy * Accuracy measure not tied to operational KPIs (Inventory turnover, service levels)	* Forecast accuracy linked with supply chain impact * Accuracy tied to operational KPIs * Errors made visible graphically * Process steps measured indivudally on value added to the final forecast	* Uses forecast errors as indicator for problems that need solving * Accuracy tied to business performance * Measuring economic value added of process * Measuring forecast value add to evaluate each step of the forecast process * Visibility through graphs
Skills	* No training * Unexperienced personnel * Subpar skills in analytics and communications * Lacking knowledge about industry	* On the job training * Access to external training, however not mandatory * Increased knowledge of market and analytics * Communication somewhat modified depending on function speaking to	* On going training from internal and external sources * Well-developed knowledge both about industry as well as forecasting methods * Communication tailored to function, speaking the same language	

Figure 5.3: *Azelios' placement in the maturity framework.*

5.2.1 Information systems support

From the conceptual maturity framework, specific aspects are essential for adequate information systems support in demand planning. *Data management* is one crucial aspect that enables the quality of the data used in the forecasting methods. *External and internal integration* is another factor that facilitates coordination both between departments and external stakeholders. *Easily understood and modern systems* enable all employees to adapt and use the information system. Lastly, *a scalable system and a shared database* are aspects important for future organizational growth.

The ERP system used at Azelio is called Monitor, and the system is as user-friendly as an ERP system can be. For demand planning, a CRM system and a field service system will be used in the future. The CRM system is not implemented yet, so there are uncertainties in how it will be used, but it will be used for forecasting and control. The field service system is more thought out, and aftermarket logistics will be managed in this system. The field service system uses information about service cycles for different spare parts. A forecast can is provided from that information system regarding which spare-part kits are needed, as the company knows how many products are live and how many hours are they have been in operation.

Integration between the ERP system and other specialized systems is handled with a developed software that acts as a coupling mechanism between Monitor and other systems. The idea is to use systems for what they are good at and integrate them with Monitor. Monitor will act as a shared database. In the current situation, there is one function fully integrated with the ERP system, Design.

Monitor has functionalities for Electronic Data Interchange (EDI) connections with external partners, but it is not used. Another functionality Monitor has is that it copies a test environment each morning with data from the day before. This gives the possibility to test how a ramp-up in demand would affect supply and produce towards that demand. Regarding possibilities to scale the system as the organization grows, Monitor is not a bottleneck. The field service- and CRM systems are both cloud-based systems making a scale-up very flexible and accessible.

Data ownership and data adjustments are handled within a Monitor-council. In this council, functions such as inventory, purchase, and finance are sitting together making decisions on data adjustments. From that meeting, ownership structures are set on employees' authority to make changes to the data.

Although all these characteristics and functionalities are prevalent within the information systems support at Azelio, it has not yet been integrated with demand planning. In the current situation, Excel is used when creating forecasts, and the input comes from a budgeted forecast with information from management meetings.

Given the current situation of Azelios' "information systems support," it is placed within the first step with some overlap to the second step of the evolutionary phases of demand planning. Currently, the technical affordance of the ERP system and the function-specific system is sufficient for their future aspirations. The information system support can handle internal and external integration. It is easily understood and scalable and acts as a shared database. However, due to insufficient data, much of the capacity has not been realized in the early phases of development.

To further advance in the framework, there are a couple of elements that need an introduction to the information systems used by Azelio. First, integration between all specialized systems needs to be integrated with the ERP system for the shared database to be fully transparent. When sales/demand data becomes more prominent and mature, these should be adjusted regarding internal events impacting the data. Forecast reports should be automatically rendered and have visible performance attached to the reports.

5.2.2 Forecasting methods

From the conceptual maturity framework, specific aspects are essential for effective forecasting methods in demand planning. *Combined forecasts* extract the advantages of both judgmental and statistical forecasts, being objective while keeping up with market events. *Segmentation of forecasting methods* enables diversifying forecasting efforts to key customers. *Documentation of adjustments* enables a learning curve effect, improving the judgmental forecasts. *Incorporating seasonality and trends* into statistical forecasts generally increases forecast accuracy.

The forecasting methods used by Azelio in the current state are solely judgmental, with no statistical methods. Azelio has tried to identify data sources of seasonality and trends by benchmarking with competitive technologies in the marketplace. However, the benchmarked technologies do not have much available historical data for Azelio to base their forecasting. Therefore, demand patterns such as seasonality and trends have not yet been identified nor incorporated in the forecasting methods. Currently, the sales department is creating a sales forecast. This forecast consists of contracts with pre-payments and non-contractual agreements with a probability rate. The sales department has a five-step sales plan process and a conversion rate that results in probability reports discussed in business and strategy reviews to end up with a budgeted forecast. The plans are aggregated on a product level, given that there is only one product to forecast at the moment. Azelio does segmentation by dividing countries into those who have grids and those who do not, the latter taking extended time in the installation phase.

Market analysts currently explore cause and effect factors triggered by external events but are not understood and incorporated into the forecasts. As this is the case, internal and external events that affect the forecast are not built into the forecasting methods. The forecasting method used has some probable assumptions: contracts will be followed through and a hit rate with a probability score. Assumptions made in the forecast are not made visible nor documented. However, the probability score is a spectrum full of assumptions that provide insight into the number of assumptions made. These are assumptions made regarding the near future. Long-term assumptions like market trends are not made visible, and there are uncertainties on what events affect the demand for the product.

Given the current situation of Azelio, "forecasting methods" are placed within the first step of the evolutionary phases of demand planning. The development of the forecasting methods has all the characteristics stated within step one of the framework. The lack of sales and industry data has led Azelio to opt for a judgmental forecasting method instead of statistical methods. The business plan drives the forecasting, which is an indicator for low process maturity. There is a segmentation of forecasting but can be developed further based on demand variability and volume as data mature. Lastly, demand patterns have not yet been identified since series production is in the implementation phase.

To further advance in the framework, Azelio needs to introduce a couple of concepts into their forecasting methods. First of all, statistical forecasting methods have to complement the judgmental forecasts made by the sales organization. Secondly, instead of relying on a conversation rate or a “hit rate” with a spectrum of assumptions, all assumptions affecting the forecasted number should be documented for learning purposes. Lastly, demand patterns such as seasonality and trend must be modeled into the statistical forecasting methods if there is a case for doing so, i.e., ice cream and the summer season.

5.2.3 Performance management

From the conceptual maturity framework, specific aspects are essential for effective performance management in demand planning. *Accuracy metrics* allow the company to quantify the effectiveness of the forecasting methods. *Evaluation of the demand planning process* allows the company to recognize a flawed process and make changes accordingly.

Azelio generally uses KPIs to measure the performance of each specific function. KPIs are not interlinked between the functions. Therefore, there is a lack of knowledge about what functions apply which measurements. The idea is to use S&OP to measure the effectiveness and efficiency of demand planning since there is a need to have high accuracy forecasts due to organizational performance and requirements made by suppliers. The sales organization is currently using "objectives and key results" (OKRs) to measure their sales process as well as their sales forecast. These OKRs include several goals – such as having a conversion rate of 50% on a 12-month sales cycle – and are connected to the overall business goals.

The struggle for performance management and measuring forecast accuracy for Azelio is a lack of actual demand data. Azelio measures their budgeted forecast versus the sales forecast against sales order and shipment dates, but due to insufficient data, it is not statistically valid until Q3. When more customer data is prevalent, and KPIs are implemented, there is an ambition to connect a forecast accuracy metric to the overall business plan to secure their long-term performance.

Given the current situation of Azelio, "performance management" is placed in between steps one and two of the evolutionary phases of demand planning. The low maturity score is primarily dedicated to the lack of data availability, making the set error measurements less valid. As the series production has been set to start in Q3, it has been impossible for Azelio to measure forecasting accuracy effectively and evaluate their demand planning process.

To further advance in the framework regarding the design variable "performance management," Azelio must introduce a couple of concepts. All functions must have a buy-in to the metric for departments to commit to a forecasting error metric. Secondly, monitoring both cumulative forecast errors and exceptional demand with control limits should be introduced to recognize a faulty demand planning process and make changes accordingly. Lastly, forecast value-added can be implemented to measure each process step of the demand planning process and continuously improve the process.

5.2.4 Collaboration and coordination

From the conceptual maturity framework, specific aspects are essential for effective collaboration and coordination in demand planning. Having a *cross-functional organization* is essential to extract the advantages of demand planning. *The dedicated function for forecasting* mitigates the risk of split efforts when forecasting. *External collaboration with major customers* entails timely information on demand increases.

Azelio is a project-driven organization. This type of organization naturally demands a cross-functional organization as it requires different skill sets for different phases in projects. For example, the customer order is a five-step process, including gates at each step. The company needs to fulfill the requirements of the current gate to proceed to the next step. The process requires several functions due to needing various skill sets. Therefore, Azelio has created a clear structure regarding responsibilities during the processes/projects. When Azelio started the transition from being an R&D-focused company to a manufacturing company, they chose a bottom-up approach to develop their internal processes for different functions. This approach has led to silos within the organization that hinder cross-functionality, resulting in functions striving to succeed with their own goals instead of having structured organizational joint goals, causing conflict interests. Although Azelio has silos, functions collaborate and coordinate activities, thanks to individual efforts instead of natural cross-functional processes.

Azelio actively tries to prevent silos by having different boards representing several functions, e.g., S&OP-board. Azelio has started to structure and develop an S&OP forum that includes inputs from several functions. The demand planning and S&OP-process have not become routine within the company yet and are currently managed by one employee.

Given the current situation of Azelio, “collaboration and coordination” is mainly placed in the first step but overlapping to the second step in evolutionary phases of demand planning. Azelio currently silos in the organization, which creates a disconnection between the functions. The disconnection between functions has received more attention as the series production is about to start, and the need for collaboration and coordination is increasing. Azelio is aware of their current situation and wants to avoid silos which is the first step to connect functions. The forecasting process is dedicated to one function, the sales organization, and, therefore, forecasting efforts are dedicated to one functional area. The sales organization is responsible and has accountability for the forecast. Lastly, Azelio has chosen an approach where capacity steers the final number, resulting in no real consensus.

To further advance in the framework, Azelio must achieve a more cross-functional organization. A cross-functional organization will help with the collaboration and coordination and decrease unnecessary costs; simultaneously, the overall efficiency has the potential to increase. Since Azelio is in the development phase of their S&OP and demand planning and their youth, Azelio has an excellent opportunity to imprint a collaborative approach in the company culture. This opportunity is a significant advantage compared to companies with already existing processes as Azelio does not have to change the behavior of employees. Lastly, Azelio must reach an absolute consensus instead of constraining their capacity to further advance in the framework. Otherwise, the actual demand is neglected, and potential orders/customers are missed out.

5.2.5 Skills

From the conceptual maturity framework, specific aspects are essential for the employees' skills in demand planning. *Internal and external training* increases the expertise of the demand planning team. *Experienced personnel* are necessary to enable an effective demand planning process, and it is said to take ten years to become an expert within the field.

The sales organization has several training programs for sales and about understanding Azelios' competitive advantage. This function is receiving education in terms of forecasting and market knowledge to understand the operating market of Azelio. The sales process is well defined, which facilitates information sharing among the sales organization. When it comes to the overall organization, there is no current system for training or educating employees. The function currently trained in forecasting methods is the sales function, but more functions will be involved in the future. Therefore, there is a gap for other functions than sales regarding training opportunities and demand planning knowledge. However, the employees have previous experience from earlier job opportunities which can partly be translated to Azelio. A common factor for all employees is that the industry/market is unknown, which results in uncertainty. Market analysts analyze trends and patterns to estimate future demand, but the uncertainty is present, which naturally permeates the entire organization.

Given the current situation of Azelio, "Skills" is mainly placed in the first step but overlapping to the second step in the evolutionary phases of demand planning. The sales function is responsible for the forecasting process as well as having the market expertise. Azelio is trying to overcome the uncertainty of the market by analyzing competitors and comparing other solutions' demand patterns. Due to Azelio's youth, employees have little experience of Azelios' context even though employees have demanded planning experience from earlier work-life. Even though people are forecasting with excellent technical knowledge and have earlier experience, understanding the organization's market is equally important, leading to the forecasting process still being challenging.

To further advance in the framework, must Azelio obtain more knowledge about their market to achieve high accuracy forecasts. Achieving high forecast accuracy is a cyclical learning process with learning and experiencing in focus by interacting with the context of Azelio, which is why time is needed to advance in the framework further. Moreover, other involved functions than sales need to be educated regarding the demand planning process.

5.3 Identified contextual variables

Two significant contextual variables were identified, affecting demand planning, *market uncertainty*, and *organizational complexity*, broken down into sub-contextual variables. Below, a table with main takeaways is shown regarding contextual variables affecting Azelio, which dictates the design of the demand planning process; see table 5.1.

Table 5.1: *Azelio's situation in terms of identified contextual variables.*

Contextual variables		**Main aspects**
<u>Market uncertainty</u>	*Data availability*	• Insufficient data for statistical forecasting methods • Demand triggering factors are explored but impact not known • Insufficient market knowledge for efficient judgmental forecasts • Seasonality and trend unknown • Insufficient data for measuring forecast errors • Employees do not trust the forecast
	Market competition	• Filling an existing gap on the market • Main competitors: Diesel engines and lithium batteries • Azelio is focusing on long-duration storage
	Regulation and political initiatives	• Regulations might increase product variants • Political initiatives can ramp up demand fast
<u>Organizational complexity</u>	*Organizational growth*	• Structures of silos • Fast-growing company • Issues of trustworthiness due to youth
	Capacity constraints in the installation phase	• Targeted installation sites are in MENA-region • Lacking infrastructure • Local terrain can lead to construction work • Customers require a different amount of effort
	Independence of income	• Listed on the stock exchange • Dependent on investors • Transparency internally and externally is affected/limited

5.3.1 Market uncertainty

Market uncertainty is divided into three subsections: data availability, market competition, and regulations and political initiatives. The following section will describe Azelios' situation relating to these contextual variables.

Data availability
The data available at Azelio used for demand planning is scarce and is thought of by Azelio as one of the most significant inhibitors for an effective demand planning process. In the current situation, orders are starting to roll in; however, data is insufficient for statistical forecasting methods.

A market function is exploring external and internal factors and how they affect the demand triggering effects. Although some triggering factors have been identified, i.e., forest fires destroying grids, they are not incorporated into the demand plan as the impact on the final number is not quantifiable. Data on customer behavior from different regions have not yet been identified. Accordingly, Azelio follows a budgeted forecast constrained by capacity, and a make-to-stock environment is established, producing 22 units each day, mitigating the uncertainty of the initial demand ramp-up.

There are also market uncertainties faced by Azelio, given the immature product and market. First, demand varies have not yet been identified. Demand for Azelio is triggered either by a product order but also through service agreements. The intermittent demand for spare parts is set to be handled by a field service system and a service portal where customers can make ad hoc order placements on spare parts. The demand pattern of product orders is more uncertain for Azelio. There is not enough data available to gauge seasonality patterns nor trends. The demand characteristics have not yet been established for the product, making it hard to set a structure for demand planning as the demand could either be stable, lumpy, or intermittent demand. To alleviate the uncertainty of demand, Azelio has chosen to build buffers initially.

The employees at Azelio are also a bit vary on trusting the forecasts used now, and some believe that there will be significant forecast errors at the beginning that need to be addressed to improve the demand planning process. Given that demand data is insufficient for measuring forecast errors and accuracy, there is little quality control of the demand plans.

Market competition
Azelio operates in a market that has received more and more attention during the past years due to the increased electricity needs worldwide. At the same time, green energy has been prioritized on the global agenda, which has started the trend, going from fossil fuels to renewable energy. The increased attention and trend shift has resulted in more businesses entering the renewable energy market, increasing competition and driving innovation. The market competition is not something Azelio can control but must be aware of as it affects their demand. Competition can come from both established companies or new companies, just as Azelio themselves. Azelio has chosen to see commercially viable solutions as their main competitors but is aware of possible start-ups and coming companies to be possible threats. Such companies can disrupt the market by developing breakthrough innovations that are challenging to foresee. To mitigate this, Azelio uses market analysts to be aware of what is happening on the market to understand future demand.

Lithium batteries and diesel engines are seen as two competitive solutions that are seen as main competitors by Azelio. Azelio has chosen not to benchmark competitors; instead, Azelio has tried to communicate with lithium providers in an attempt to determine the demand patterns and industry benchmark forecast accuracy but without success.

Lithium batteries have the capacity to supply energy for about 4-6 hours, but Azelio's solution can store energy up to 13 hours. The longer duration storage means that Azelio's solution can supply electricity around the clock, which is the current gap in the market Azelio aims to fill. The TES.POD is proven to have a lower carbon footprint than its competitors and is using recyclable components. The longer duration storage possibility with green energy is Azelios' edge and their way of differentiating themselves from other potential competitors.

Regulations and political initiatives
Regulations and political initiatives can dictate the design of the demand planning process for Azelio. The market department analyzes future regulations and laws by using a roadmap for market entries to map regulations, laws, certifications, and critical collaboration partners. Specific regulations can result in more variants of the product.

The political- and green initiatives are factors that influence Azelios' demand. Political initiatives can highly increase or decrease the demand for Azelio's products; for example, the initiative made by Biden investing 2.25 trillion dollars in sustainable infrastructure. Initiatives such as the Paris agreement hold countries accountable for being climate neutral by the year 2050. Given the new market, external factors such as these mentioned above have not been gauged by Azelio and how it affects demand but are known to be affecting the demand planning process. The majority of regulation and laws being implemented benefits the business of Azelio but in developing countries, which is a targeted market for Azelio, are not as focused on sustainability issues.

5.3.2 Organizational complexity
Organizational complexity is divided into three subsections: organizational growth, capacity constraints in the installation phase, and independence of income. The following section will describe Azelios' situation relating to these contextual variables.

Organizational growth
The organization of Azelio is growing fast as the number of employees has grown from 68 to 153 from 2018 to 2020. The high pace of growth is resulting in increased complexity of collaboration and coordination within the organization. The growth rate and their transition from being an R&D company to a manufacturing company put pressure on developing processes at each specific function and routines regarding how to communicate. Currently, Azelio has structures of silos as each function has focused on developing their process, a bottom-up approach, instead of having a holistic approach. Having silos has not been a problem since the complexity for communication is more straightforward for smaller organizations but as the organization has grown, so has the complexity.

Additionally, as the organization has grown, functions within the organization have been placed in different geographical locations, increasing the complexity of communication and collaboration. Having silos has been paid attention to as the organization has moved closer to commercialization and series production. Cross-functional boards (S&OP-, Product-, Risk-boards) have been established to close the gap between different functions. Another prerequisite seen by Azelio is to create virtual dashboards for forecasts in the demand planning process, facilitating transparency and cross-functional engagement. Azelio aims to be ISO certified where they map and document all functions processes that they wish to be a facilitator in terms of cross-functional cooperation.

Trustworthiness is another factor affecting Azelio due to their youth and not yet commercialized solution. Trustworthiness affects possible customers as they want to know if Azelios' solution works the way it is supposed to. Therefore, Azelio verifies their solution by using third-party actors to test and compare against similar competitive solutions. Azelio is focusing on high-intensity marketing of their solution to increase brand awareness. To further increase brand awareness and trustworthiness, Azelio is marketing early order deliveries/installation. Therefore, Azelio created a plan with milestones regarding their communication to the market/public regarding technology and project performances. Trustworthiness also affects suppliers since suppliers must make investments to be able to produce Azelio's parts. Since Azelio is a young company, not all suppliers are willing to invest in needed equipment themselves, which requires Azelio to co-invest in the required equipment with some suppliers. Being a young company comes with issues regarding trustworthiness and risk-taking; it also attracts attention which comes with great business opportunities. However, both customers and suppliers weigh the correlation between risk versus reward, which Azelio is trying to mitigate by the aforementioned actions.

Capacity constraints in the installation phase
A contextual variable that might affect the demand planning process is the critical capacity dedicated to the installation phase. Azelio has control over both the production and the installation of the TES.PODS. The company describes that the bottleneck will not be within production; instead, it will be the installation phase. Currently, Azelio is planned to manage the installation and hire third-party installation firms in conjunction with demand ramp up. Azelio wants to outsource the installation phase since they aim to focus on their core business, being a technology provider. Therefore, the installation phase will affect demand planning to a start as each site is unique with different requirements resulting in added uncertainty for planning.

The demand planning process will be affected by the infrastructure of the country/region where the customers are prevalent. Most of Azelios' startup customers are based in countries (MENA region) with insufficient infrastructure, necessitating split shipments over a time period. Specific barriers in different countries can be hard to foresee early in the ramp-up. The unforeseen barriers could hinder the installation by being delayed in customs clearance and cause capacity constraints. Current barriers from restrictions caused by Covid-19 are also a limiting factor that hinders in-house resources to travel to different customer countries.

The local placements of the PODS at the customer site will dictate the ease or hardships of the installation. The terrain surrounding the installation site might necessitate reconstruction to start installing the products in certain regions. Azelio wants customers to manage all the construction work; however, there are uncertainties in the current situation. This factor affects the ease to fulfill orders and negates the efforts put into forecasting for specific customers/regions. In conclusion, these factors are highly affected by a relatively close estimation of demand to enable a capacity ramp-up of critical installation resources to meet future requirements.

Independence of income

Azelio, like any company, is dependent on having the capital to be able to continue its growth journey. Azelio is listed on the stock exchange, Nasdaq First North Growth Market in Stockholm, which comes with demands and expectations from investors. A positive effect from being a public company is the direct feedback from the stock market, as releasing news creates reactions, which therefore creates an understanding of the market's expectations. The listing on the stock exchange has benefited Azelio as more cash has been available in their journey towards industrialization. The board of Azelio decided to make a share issue 2019 to continue their business and liquidity plans. In 2020 Azelio decided to have another share issue 2021 to finance the transition from innovation to industrialization. Since Azelio has not yet achieved a positive cash flow, they are dependent on investors to survive, which puts pressure to deliver good news in line with their long-term plan to live up to the expectations. Therefore, Azelio has developed a strategy regarding their communication to the shareholders and the market to share their short- and long-term progress to satisfy their current shareholders and attract new investors.

The organization itself is affected since transparency internally and externally is limited due to insider trading risk. Azelio has developed standards for dealing with sensitive information to prevent the risk of leaking valuable information. Restrictions for communication result in constraints regarding collaboration and coordination as the transparency is limited. The adverse effects of being a public company can be derived from a couple of factors. Every time a contract is being signed, the participants also need to sign a non-disclosure agreement. Given that many employees are involved in delivering projects, it becomes problematic keeping the information within a confidential group. It becomes a gray zone regarding whom one can talk openly to and where to restrict information.

Today, the transparency issue mainly adheres to internal communication as Azelio has a fixed number of production units communicated to external actors. Therefore, transparency is not affected externally in the short run to the same extent. Many of Azelio's suppliers are smaller in size, and as the volumes ramp up, they must increase capacity accordingly, which might lead to capacity constraints in the long run.

A prerequisite for mitigating the issue of transparency and insider trading, according to Azelio, is to have a framework for educating existing and new employees regarding this manner in detail, which now is lacking. Azelio believes that this issue depends on how fast volume rises within targeted markets but thinks it will affect them for at least a couple of years. The issue of transparency affects the ability to plan and prepare for future needs internally but also externally when it comes to, for example, securing suppliers that can deliver accordingly.

6. Contextual variables impact on design variables

This chapter describes how each design variable is affected by the identified contextual variables, see figure 6.1. The contextual variables consist of six sub-variables that represent two variables: *market uncertainty* and *organizational complexity*.

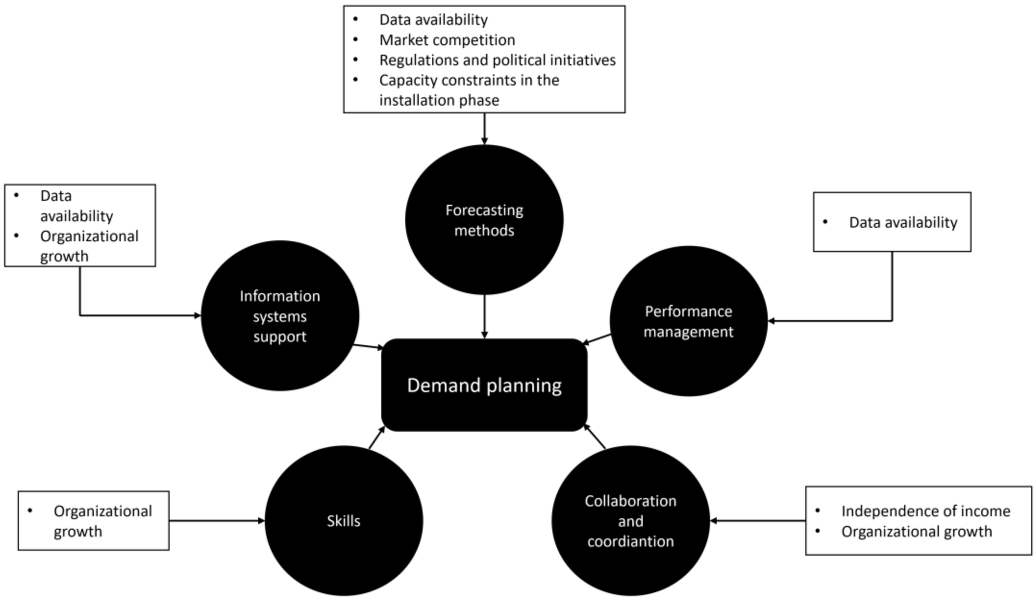

Figure 6.1: *The contextual variables impact on design variables.*

6.1 Market uncertainty

Market uncertainty is divided into three sub-contextual variables: *data availability, market competition,* and *regulations and political initiatives*. These variables are comparable to the dynamic complexity dimension mentioned by Jonsson and Kristensen (2018), where insufficient data, market competition, and the political landscape create demand uncertainty.

6.1.1 Data availability

Data availability impacts/restricts progress for three design variables: Forecasting methods, Information systems support, and Performance management at Azelio. For an overview of data availability and its impact on design variables, see table 6.1.

Firstly, looking at Azelios' situation regarding data availability effects on forecasting methods, the contextual variable is significantly restrictive. As mentioned before, due to the lack of sufficient sales data, Azelio has had to opt for judgmental forecasts based on contractual agreements and non-contractual agreements with a probability rate. The insufficient data at Azelio makes statistical forecasting methods non-viable or even impossible to use. Specific facilitators can ease the development within the design variable forecasting methods. The boring answer is to let time do its part and get enough data to make reasonable statistical forecasts, most often data time series of at least two years to model seasonality into the forecasts (Stadtler et al., 2015). Another possibility is finding an industry data source of a similar product. With that, there are two prevalent methods for forecasting new product launches. The first one uses time series from similar products to determine life-cycle factors. These life cycle factors are then multiplied with an average demand to forecast for specific periods to get a forecasted number. The second method establishes phases of increases, decreases, and a steady state. The only data needed for this method is the length of each phase. According to Syntetos et al. (2016), these methods are uncertain and need to be complemented with actual demand as soon as possible. Although some guidance can be derived from these methods, more established statistical forecasting methods should be used when data is sufficient.

The need and efficiency for information systems in demand planning are negated by data availability. Azelios' information systems support is characterized by a high degree of technical affordance. It is scalable, easily integrated with other systems, has potential for external connections, and acts as a shared database, which is a sign of high maturity (Mentzer et al., 1999; Vereecke et al., 2018; SAS and Purdue University, 2008). The current situation with insufficient sales data and a lack of a solid forecasting process restricts the information system's potential to facilitate demand planning. The restrictive manner of the insufficient data currently experienced by Azelio leads to some apparent predicaments in demand planning development. As series production has not yet started, there are insufficient sales data stored, restricting the information systems due to data immaturity. The current situation has not allowed Azelio to gauge internal events' impact on demand and therefore does not complement demand data accordingly in the systems. Data availability, or rather the lack of available data, makes system-generated forecast reports with visual performance impossible to produce automatically. Facilitators to manage the insufficient data and the development within information systems support are few. The short and not-so-fun answer is that time and sales will increase the data maturity and facilitate development within information systems support in Azelios' case.

The last design variable affected by data availability is performance management. What is needed to start measuring forecast errors is a one-time bucket of actual demand during a forecasted time bucket. In this term, performance management is not as data-heavy to develop within as other design variables. There needs to be a decided metric, formula to use for forecast accuracy, and aggregation levels to measure to start as that first-time bucket of demand rolls enters the system. Therefore, facilitators for performance management are time and actual demand.

Table 6.1: *Facilitators for the contextual variable "data availability".*

Contextual variable	**Affected design variables**	**Facilitators**
Data availability	Forecasting methods	• Time and orders • Industry data source • New product forecasting methods
	Information systems support	• Data input in information system • Time

	Performance management	• Time • Sales data

6.1.2 Market competition

The design variable forecasting methods are affected by the contextual variable market competition; see table 6.2. Azelio sees the main competition as commercially viable solutions such as lithium batteries and diesel engines. There are also up and coming companies with solutions able to store energy for longer durations. The market competition will dictate how much effort Azelio needs to put into its forecasting process. Depending on the industry benchmark for forecasting accuracy, Azelio will have to invest more or less in its forecasting efforts.

Azelio has found some gap in the market supplying an environmentally friendly energy solution in developing countries where competitors have not established a strong market position. Inevitably, customers have become accustomed to delivery precision and react to stimuli from both company sources and external sources in a set way from earlier market experiences. The reaction of customers to external and internal stimuli will affect the focus of the judgmental forecasts and the consensus meetings held to agree on a final demand plan.

There are a couple of facilitators that can ease the market entry and demand planning development early on. The first facilitator is benchmarking the main competitors in the market environment on forecast accuracy. Setting a realistic goal that should be close to the market standard on forecast accuracy is beneficial in two ways. Realizing a higher forecast accuracy might establish a competitive advantage. However, it can also concur a costly process that the customers do not fully appreciate. Vice versa will lead to lost customer sales who opt for competitors' solutions. The second facilitator incurs finding an industry data source of actual demand values during a period and analyzes extreme demand values. Tying the extreme demand values of competitors to external events can give insight into elements needed to be incorporated in judgmental forecasts and topics to discuss in the consensus meetings.

Table 6.2: *Facilitators for the contextual variable "Market competition".*

Contextual variable	**Affected design variable**	**Facilitator**
Market competition	Forecasting methods	• Benchmark competitors on forecast accuracy • Exploration of internal and external factors from competitors affecting demand analyze demand data

6.1.3 Regulations and political initiatives

The contextual variable regulations and political initiatives affect the design variable forecasting methods, see table 6.3. Azelio is a company with an ambition to make the world a greener place. It is affected by the megatrend and green initiatives employed throughout the world. Examples affecting the demand are Biden's initiative for sustainable infrastructure and the Paris agreement. The initiatives can change the energy mix and highly increase the demand for Azelio's products, affecting judgmental adjustments on forecasts. Regulations in different countries will also dictate which voltage is used, making Azelio opt for variants of the solution. An increased number of variants will also increase the complexity of forecasting and necessitate segmentation of forecasting methods.

Specific facilitators can ease the development of demand planning and structure the forecasting efforts. Mentzer et al. (1999) propose to handle variants with the segmentation of variants and forecasting efforts. Azelio is currently segmenting forecasting efforts by countries with grids and those without, the latter being managed by MTO due to a more extended preparation phase before installations. However, this segmentation should expand as variants are introduced to include product variants. Mentzer et al. (1999) and Croxton et al. (2002) propose ways to establish segmentation via differentiation of customer sensitivity or product value and demand variability and volume. Given that the political landscape highly impacts the industry, the process could be facilitated by expert knowledge in the political domain during the judgmental forecast step in the demand planning process.

Table 6.3: *Facilitators for the contextual variable "regulations and political initiatives".*

Contextual variable	**Affected design variable**	**Facilitator**
Regulations and political initiatives	Forecasting methods	• Framework for segmenting forecasting • Judgmental forecasts facilitated with expert knowledge

6.2 Organization complexity

Organization complexity is divided into three sub-contextual variables: *organizational growth*, *independence of income*, and *capacity constraints in the installation phase*. These variables can be connected to the detailed complexity dimension mentioned by Jonsson and Kristensen (2018), creating complexity in the supply chain.

6.2.1 Organizational growth

The contextual variable organizational growth affects demand planning by the three design variables: *information systems support, skills*, and *collaboration and coordination*, see table 6.4.

Information systems support is a prerequisite for organizations to extract and store data. As the organization grows, the data grows too, which results in needing more data to be stored, structured, and analyzed. The increased data complexity puts pressure on the systems used by Azelio in terms of performance and the ability to connect functions. It is common to use less advanced systems in the early phases of organizational growth, but more advanced systems are required for different use areas as the organization grows. So, the case for Azelio is as they are already moving from simpler systems to more advanced to ensure those information systems are not a constraint on their journey to become an established company. Vereecke et al. (2018) argue that information systems support is a prerequisite to mature the demand planning process, supporting Azelios' choice regarding focusing on information systems support. To facilitate the correlation between organizational growth and information systems support, a cross-functional organization is crucial. Information systems can be seen as an enabler that facilitates integration between functions, but they cannot be the only facilitator. Having a shared database where all functions can extract information resulting in decision-making using the same data reduces the risk of making counter-productive decisions. Additionally, visualizing the forecast leads to a more integrated and transparent organization and could facilitate identifying gaps in data that affect the forecast.

The following design variable affected by organizational growth is skills. Azelio is a young and inexperienced company as they have not yet fully started to commercialize their solution, making the personnel inexperienced in terms of Azelio contextual factors. The lack of experience creates uncertainty within the organization and complicates the designing of processes and decision-making. Therefore, Azelio chose to employ more experienced individuals from other manufacturing companies or individuals with relevant experience to mitigate this issue. The organization naturally transforms during an expanding phase which changes structures, processes, and routines. In the early phases of business growth, communication and coordination are less complicated than when functions start to be spread out geographically and the number of employees increases. Azelio has chosen a bottom-up approach which means that each function has developed its processes and routines, which, to some extent, results in silos and complicates demand planning. To facilitate organizational growth concerning skills, it is vital that top management has a clear focus and communicates that establishing a demand planning process is essential. This clear focus makes employees feel confident in putting time and effort into developing a successful process instead of putting pressure on few individuals. Workshops for all demand planning participants are an excellent way to understand the process and understand other functions' perspectives. Lastly, having a well-thought demand planning process as a foundation for learning from overtime and building experience is a primary facilitator.

The last design variable being affected by the contextual variable, organizational growth, is "collaboration and coordination." Collaboration and coordination have already been touched upon in the other design variables affected by organizational growth. Both collaboration and coordination get more complex the more as the organization grows. SAS and Purdue University (2009) argue that having a successful internal collaboration is crucial for achieving a consensus in the demand planning process. Continuously, it is easy to create silos that prevent effective collaboration and coordination, as each function is focusing on developing its processes. Barratt (2004) argues that it is common for companies to believe they are cross-functional when integrating two functions. However, Azelio does know that they are not cross-functionally integrated and aware of having silos. Mentzer et al. (1999) describe how coordination reduces the more mature a demand planning process simultaneously as the organization gets more cross-functional, resulting in coordination imprinted in the company culture. Azelio is still a company in a start-up phase and has many opportunities to create a cross-functional organization that facilitates collaboration and coordination in the demand planning process. Therefore, it is crucial to have information systems supporting the communication between functions. As Azelio already has planned, having team-building days would boost the relations between functions and increase understanding of other functions. Lastly, Azelio has started to implement cross-functional boards, which is a facilitator to be more collaborative and ease coordination among functions.

Table 6.4*: Facilitators for the contextual variable "Organizational growth".*

Contextual variable	**Affected design variable**	**Facilitator**
Organizational growth	Information systems support	• Integration between functions • Common database • Visualize forecasting reports
	Skills	• Clear focus from top management • Workshops for demand planning participants • Experienced personnel
	Collaboration and coordination	• Information systems support • Team building days • Cross-functional boards

6.2.2 Independence of income

The contextual variable independence of income affects the design variable collaboration and coordination, see table 6.5. Firstly, being a public company creates transparency issues as sensitive information can be leaked and affect the share price. As having a transparent organization where information is shared cross-functionally is a prerequisite for successful demand planning, collaboration and coordination are critical. Brandes and Darai (2017) argue that transparency is a prerequisite to achieving a collaborative organization, but transparency also helps employees understand the company's fundamentals leading to better decision-making. Collaboration can suffer both internally and externally. Internal transparency issues affect the information-sharing mechanism, which limits communication. Internal transparency issues make planning suboptimal as sensitive information cannot be shared with everyone. External transparency issues can limit the robustness of the supply chain as suppliers cannot be prepared for possible coming orders. Azelio is mitigating the external transparency issues by communicating an expected capacity instead of actual orders. Currently, the information is more sensitive as the stock itself is volatile, and Azelio has not yet been recognized as an established company. Being a new company on the stock market could lead to liquidity issues if the investors are unsatisfied with the performance of Azelio. Liquidity issues could also cause stress within the organization to constantly deliver good news, affecting the long-term plan as decisions could be sub-optimal. However, this type of stress seems not to be present in the organization but is a factor that could affect demand planning.

Clear guidelines and routines regarding sensitive/classified information should be developed to tackle the transparency issue concerning collaboration and coordination. Currently, Azelio has developed routines regarding managing insider trading, but employees who receive classified information rely more on gut feeling to assess the information sensitivity. Lastly, time in the market is needed to lead to a continuity of incoming orders and volumes from targeted markets. Time will also help Azelio to build great partnerships and build relations with suppliers.

Table 6.5: *Facilitators for the contextual variable "independence of income".*

Contextual variable	Affected design variable	Facilitator
Independence of income	Collaboration and coordination	• Clear guidelines and routines for sensitive information • Continuity of in-coming orders and getting volumes in targeted markets • Time in market

6.2.3 Capacity constraints in the installation phase

The contextual variable "capacity constraints in the installation phase" affects demand planning by the design variable "forecasting methods," see table 6.6. The installation phase is the last step in the supply chain of Azelio and the step before handing over the site's responsibility to the customer. This step makes Azelio's supply chain somewhat unique, which results in more uncertainty being built in as there is one more step that could cause problems to manage. The installation phase increases the detail complexity by adding one more step to fulfill the demand. Each site being installed is unique from the other, which requires Azelio to be flexible and aware of possible scenarios that could delay the installation. Possible scenarios are related to different countries, environments, and events that could occur. An example is lack of sufficient infrastructure leading to transshipments or re-routing the delivery resulting in a delay in delivery. Another issue for Azelio is that they are still inexperienced doing these installations, and therefore, there is a high degree of uncertainty present in this phase. Additionally, creating and installing sites is not the core business of Azelio.

Therefore, to facilitate the contextual variable capacity constraints in the installation phase, Azelio should document different scenarios that could cause interruption and delay delivery to customers. Scenario planning would help Azelio be prepared for these scenarios and detect possible issues that could occur that otherwise would not be detected. This documentation would most likely result in a learning curve effect, according to Wallace and Stahl (2008), and would therefore improve the judgmental forecasts. Additionally, segmentation of customers concerning how much risk the customers imply (e.g., Lack of infrastructure, local conflicts, and customer behavior) could be preferable. It would result in a guideline on how the planning should be executed for specific customers. The installation phase is not a core business for Azelio and, therefore, not their expertise. Azelio is also aware of the possibility of this step becoming a bottleneck. However, if it becomes a reality, more money will be spent on more resources to avoid this scenario. Until the installation phase is outsourced, Azelio must opt for longer forecast horizons and, in a stepwise manner, outsource the installation to third-party providers and mitigate the risk of this phase becoming a bottleneck or a money eater.

Table 6.6: *Facilitators for the contextual variable "capacity constraints in the installation phase".*

Contextual variable	**Affected design variable**	**Facilitator**
Capacity constraints in the installation phase	Forecasting methods	• Documenting possible scenarios of interruption • Segmenting customers • Long forecasting horizon • Learning curve effect

7. Discussion

This research aims to increase the understanding of the fit between contextual variables and demand planning processes. This chapter discusses the findings, provides answers to the research questions, and highlights theoretical and practical implications and research limitations. Lastly, a discussion regarding environmental, societal, and ethical aspects is given

7.1 Challenges new companies experience when implementing demand planning

Research question one aimed at identifying challenges new companies experience when implementing demand planning. The study identified six contextual variables that hinder demand planning development in early business growth phases. The variables encompass *data availability*, *political initiatives and regulations*, *independence of income*, *market competition*, and capacity *constraints in the installation and organizational growth.* There was no literature found in this study that directly focuses on challenges that new companies experience when implementing a demand planning process. The focus is more often on forecasting new products, a challenge in many companies.

The findings are comparable with the findings made by Jonsson and Kristensen (2018) regarding the context in S&OP, i.e., firm size, detail complexity, dynamic complexity. According to Vereckee et al. (2018), firm size increases the complexity of coordination and communication. Findings confirm such a relationship. Azelios' organization increased in coordination complexity as the company grew. According to Jonsson and Kristensen (2018), detail complexity increases the need for efficient coordination. Azelio does experience increased coordination complexity from a unique process step with an installation phase. Dynamic complexity is said to increase the complexity of planning. Findings supported this relationship. Azelio does experience increased demand uncertainty and complexity in planning from insufficient data, political initiatives and regulations, and market competition.

The findings regarding challenges and contextual variables experienced by Azelio are transferable to other new companies in the early phases of business growth. Data availability before series production is a scarce resource that can be facilitated with specific forecasting methods. On the other hand, the independence of income affects companies' stock exchange, meaning that it is not transferable for new unlisted companies. Therefore, the unlisted companies might not experience similar transparency issues internally regarding demand planning as the listed companies do. Organizational growth is a contextual variable that affects most up-and-coming companies and their demand planning. Using Azelio as an example, the company did not experience collaboration and coordination issues in the project phase. The transition to series production has led to more employees and functions, which has led to an extended need for mechanisms to handle the complexity.

The findings are beneficial as they provide insights into what contextual variables can affect new companies' ambition to develop their demand planning process.

7.2 Prerequisites developing demand planning maturity

Research question two aimed at identifying prerequisites for developing demand planning maturity. Prerequisites were mainly found by comparing design variables from the maturity framework with affecting contextual variables and linking it with literature to support the prerequisites.

Data availability is one of the contextual variables that affect the dynamic complexity. The variable affects three design variables dedicated to demand planning: information systems support, forecasting methods, and performance management. Jonsson and Kristenssen (2018) propose using scenario planning to prepare for possible outcomes and handle dynamic complexity stemming from insufficient data. However, scenario planning is not a prerequisite for maturing the demand planning process; it only mitigates the uncertainty. The findings showed that facilitators, such as an industry data source, new product forecasting methods, time, and sales, are prerequisites for development within the three design variables. These findings are generally transferable and applicable for other new companies going from a project phase to production, given that insufficient historical data is prevalent in those situations.

Market competition is another contextual variable that affects Azelios' progression of demand planning and affects the dynamic complexity. Market competition affects one design variable in demand planning, forecasting methods. Market competition does not necessarily hinder demand planning development, but it sets a standard on forecast accuracy and, thus, the efforts into the demand planning process. For the market competition, one needs to understand the market environment and set the level of forecasting efforts accordingly. No prerequisites for handling market competition in forecasting were found in the literature. The interviews gave a couple of facilitators for knowing what effort to put into the forecasting process and how to understand the market's reaction to stimuli. One prerequisite mentioned by Azelio is to benchmark the competitors on forecasting accuracy. Another prerequisite is to find an industry data source and couple demand peaks of competitors to external events, therefore understanding the market environment better when forecasting. Given that no literature was found to strengthen these prerequisites, the validity of the findings suffers.

Political initiatives and regulations experienced by Azelio do increase the dynamic complexity and affect the forecasting methods. Prerequisites for handling the contextual variable "political initiatives and regulations" and its effect on demand planning development have not been found in the literature. Therefore, logical links between developing the forecasting methods and the effect of the political landscape Azelio experience had to be made. A prerequisite for handling the increase of variants stemming from regulations in different countries is to develop a framework for segmentation of forecasting (Mentzer et al., 1999), and therefore increase demand planning maturity. For a company highly affected by political initiatives, a facilitator for judgmental forecasting could be an expert panel with domain knowledge within "green" politics (Stadtler et al., 2015). Expert panels are a prerequisite for Azelio to develop their forecasting methods regarding judgmental forecasts. The findings are specific to companies like Azelio, where the market percentage and product changes with regulations and political initiatives. Therefore, the findings might not be applicable nor transferable to other companies in industries less affected by the political landscape.

The *organizational growth* experienced by Azelio does increase the detail complexity and affects coordination and collaboration, skills, and information systems support. According to Vereecke et al. (2018) and Jonsson and Kristensen (2018), prerequisites for managing a growing organization are information systems support that facilitates coordination between departments and units. The findings from this study are in line with these authors' statements but have some additions. The findings from the case study at Azelio indicate that hiring experienced personnel and training new personnel indicates a mature demand planning process and a prerequisite for developing it further. Employing cross-functional boards to facilitate coordination and collaboration is also indicative for maturing the demand planning process. Integrating functions, information systems and facilitating visibility with a shared database will ease the coordination. These findings hold some validity as the findings can relate to other authors' work. The findings are generally transferable and applicable for new companies as organizational growth is bound to happen for any successful start-up.

Independence of income is a unique contextual variable experienced by Azelio that affects collaboration and coordination. The variable affects the transparency in the organization both internally and externally, as information regarding orders must be held within a confidential group. How being listed on the stock exchange affects the collaboration and coordination required for demand planning have not been paid attention to in the literature. The findings from the case study show that some believed prerequisites need to reduce transparency issues stemming from income independence. The prerequisites are time in the market, continuity of orders, and clear guidelines for sensitive information. The validity of these findings is low as no literature was found regarding the topic, and only one companys' situation was explored. The findings might be transferable to other newly public companies, but the findings are not rooted scientifically and proceed with caution.

Capacity constraints in the installation phase add detail complexity to Azelios' supply chain and the dynamic complexity experienced by the company for some predicaments that need to be addressed with the design of forecasting methods. Dynamic complexity is in literature proposed to be addressed with scenario planning that has also been a prerequisite for developing the demand planning in Azelios' situation. Documenting scenarios is a prerequisite for Azelio to advance their forecasting methods to outsource the capacity-constrained installation phase on time and document and learn from what risks customers from different developing countries imply regarding order fulfillment. Information from the documentation can be used to segment the forecasting methods, which is seen as a prerequisite for advancement in demand planning (Mentzer et al., 1999). These findings can be transferable and applicable to new companies where dynamic complexity is prevalent, whose target market is developing countries.

7.3 Limitations of methodology

The data gathering first focused on developing a deeper understanding of the subject, demand planning. The data gathering was done mainly by reading academic papers and discussing with the supervisor from the focal company in the case study how they define demand planning. There are not many papers covering demand planning and its development in companies in the early phases of business growth, limiting the validity of the data collection. To mitigate this issue, benchmarking at companies that have already done the transition from being a new company to an established firm could have been done. Due to time restrictions and Covid-19, the benchmarking approach was not chosen. Therefore, the case study is based on one company, Azelio. Doing a single-case study affects the reliability as the results of the study were not tested at other companies.

The interview approach chosen was semi-structured, enabling the authors to be flexible and adaptive in the interview. Bryman and Bell (2011) argue that having a structured approach makes structuring data easier while facilitating reliability. This approach was not suitable for this study as demand planning is a complex phenomenon and causes difficulties when formulating the questions. Additionally, the interviews were tailored for the different interviews to some extent, but all questions were asked to several participants to increase the reliability.

A total of eight people with different titles from several functions were interviewed, and four of the participants were interviewed twice. During the interview phase, it was a focus to achieve triangulation to ensure data validity.

7.4 Theoretical and practical implications

Theoretical implications of this study are twofold. Firstly, the study suggests that demand planning development in early business growth is constrained by context. The study identified six variables affecting demand planning development that inhibited demand planning maturity. Future research should focus on generalization of contextual variables affecting demand planning early on in business growth by studying several start-up companies trying to implement a proper demand planning process. Secondly, the study implies that the constraining effects contextual variables have on demand planning development can be facilitated with specific actions. Future research should focus on deepening the knowledge in terms of facilitators that can increase the pace from an implementation-phase to a mature demand planning process in early phases of business growth.

The practical implications of this study highlight the difficulties of implementing a demand planning process for business in the early stages of business growth. To understand the current state of the demand planning process, companies should use a maturity framework consisting of design variables to develop the process. It is impossible to transfer the guidelines in the maturity frameworks as each company is unique, facing different challenges. The study identified contextual variables to increase the understanding of the individual company context. Combining the design variables that directly affect demand planning with contextual variables that indirectly affect demand planning makes it possible to tailor the demand planning process suitable for the specific company.

7.5 Consideration to societal, environmental, and ethical aspects

Demand planning is a critical process for the overall S&OP process. A mature demand planning process correlates with having effective and efficient processes within the organization (Vereecke et al., 2018). Having well-developed processes results in better work conditions for the employees as their time becomes more efficiently used, which most likely makes overtime less needed. Demand planning is about meeting the demand, having high service levels, mitigating the risk of overstocking and the risk for leftovers (Vereecke et al., 2018). Having an efficient demand planning process also contributes to allowing the company to consolidate transportation and reduce the environmental impact.

Before the interviews, each interviewee was informed of the interview's purpose and asked if it were okay to use their input in the study since consent is essential, according to Bryman and Bell (2011). Names of the interviewees were left out due to each individual's respect, nor were the interview notes included in the report and were only read by the authors. Lastly, eventual critics are not directed towards any employees, only towards organizational structures and processes.

8. Conclusion

This research aims to increase the understanding of the fit between demand planning processes and contextual variables. A maturity framework was developed based on literature to map the demand planning development at a company in the early phases of business growth. The framework contributes to understanding a company's current demand planning maturity and what is required to advance in the evolutionary phases. Contextual variables were identified and investigated to determine each design variable's effects in the maturity framework. The study's contribution can be summarized as a foundation for companies regarding how to understand their current demand planning maturity, how to advance in the evolutionary phases, and what contextual variables affect the process to tailor their demand planning process accordingly.

The theoretical contributions of this study can be divided into three central grants:

1. The study has generated insight into challenges companies face in the early phases of business growth when establishing a demand planning process.
2. The study identified six contextual variables that affect both the design and the possibility of advancing through the maturity framework.
3. Facilitators for contextual variables when developing maturity in demand planning were identified in the study.

One major limitation is that the case study only contained one company, limiting the study's result. The result of the study has not been tested, which decreases the reliability. Facilitators for some of the variables were not found in the literature. Instead, facilitators were found during the interviews, together with the authors making reasonable assumptions.

In the study, two main contextual variables and six sub-contextual variables were identified to be affecting the demand planning process. Still, there are most likely more contextual variables to consider. During the data gathering process, it was challenging to find literature discussing contextual variables, forcing the study to identify contextual variables using the interviews as the foundation. The lack of generalization resulted in the findings being specific to the case study. Therefore, the study's relevance could have been increased by interviewing more companies in a similar situation. Hence, this study could be considered too specific to be applied by other researchers and companies.

A suggestion for further research could be to go deeper into demand planning development for business in the early phases of business growth as there is a current gap in the literature on this topic. A valuable addition would be to identify more contextual variables affecting the demand planning process by investigating several companies operating in different industries.

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Appendix A - Interview guide: Round one

Business model

- What is the main problem that Azelio solves for the customers?
- Who are the key customers and what makes them buy the product?
- What do you believe is most important for your customers in terms of lead times, price and quality?
- What triggering events make your future customers search for your solution?
- What are the alternatives to your solution? (Competitors)
- What are the main sources of revenue as well as costs?
- What key performance metrics are used to control the overall business?

Introduction

- Can you explain why the demand planning process is being implemented?
- What do you believe your role is within the demand planning process?
- How are short term operational decisions/plans aligned with your long term strategy?
- What are the main challenges you experience when forecasting future demand?

Demand planning process

- Can you explain how your demand planning process is set up?
- What are the intended inputs and outputs from each activity within the demand planning process?
- Which functions are intended to be involved in the process?
- How are decisions made in the demand planning process? Who makes the decision for the demand planning process?
- What is the typical planning horizon for Azelio? a) 0-3 weeks b) 0-3 months c) 3-6 months d) 6-12 months e) 18-24 months
- In what frequency is this process intended to be carried out?

Information systems support

- What information system and technologies are to be used by Azelio for demand planning?
- To what extent would you say that your information system is integrated between functions?
- Is this system automated to some extent?
- Does the information system meet the requirements for future goals?
- Is the system easy to use and understand?
- What possibilities are there to scale up the system as the organization grows?
- To what degree is Azelio able to combine forecasts from different departments into one consolidated forecast?

Collaboration and coordination

- How is internal collaboration and coordination between departments managed at Azelio?
- How are you managing communication with external partners?
- How is information shared between internal and external partners?

- Are meetings held to discuss exceptions between you and partners?
- Is real time data available and shared between you and your partners?

Forecasting methods

- Can you explain your forecasting process?
- What forecasting methods are being used? Statistical methods and/or judgmental?
- How are internal and external situations managed to maintain the relevance of the forecast?
- To what extent are assumptions made visible in the forecasts?
- What is your approach when it comes to forecasting? Are you forecasting on individual product level or aggregating on a product group/family level?
- To what extent are judgments from the forecasts logged?

Performance management

- What key performance indicators (KPIs) are you using to measure the demand planning process?
- Do you have an forecasting accuracy goal?
- How is/will the efficiency and effectiveness of the demand planning controlled?
- To what extent are the KPIs connected to the overall business goals?

Skills

- How are training opportunities made available for employees working actively within the forecasting process?
- How is the organization supporting cross-functional collaboration?
- To what extent does the demand planning process receive top management support?

Appendix B - Interview guide: Round two

Market uncertainty

Market competition

- Who are the firsts to come to your mind when thinking of your main competitors?
- Are there any similar startups that you see as potential competitors?
- How does market competition negate the need for high accuracy in forecasts, do you benchmark with competitors?
- Are you seeing lithium batteries and diesel engines as real competitors?
- Our view of your edge on the market is that you are able to supply green energy around the clock. Could you elaborate on your take on the competitive edge of your solution?
- Is it the truth that you are the only actor on the market being able to supply green energy around the clock?
- To what extent does the market competition and market uncertainty affect demand planning at Azelio?

Regulation and political initiatives

- Regulation and political initiatives are difficult if not impossible to control. How does azelio make sure to be up to date of current and future regulations and political initiatives?
- Sustainability is a very hot topic which benefits your business. Have you seen any laws or regulations that have affected your business positively or negatively?
- How are you seeing the future when it comes to regulations and laws? Large possible market shares, narrower markets and so on?
- To what extent does regulations and laws affect demand planning?

Organizational complexity

Organizational growth

- To what extent would you say silos exist within Azelio?
- How are you going to avoid silos and ease communication in the future?
- What do you see as prerequisites to start working more cross-functional?
- To what extent would you say Azelios youth affects your trustworthiness for both suppliers and customers?
    - What actions are taken to mitigate these uncertainties regarding trustworthiness?
- To what extent does the organization complexity affect demand planning at Azelio?
- What do you believe are prerequisites for handling organizational complexity in demand planning as the organization grows?

Independence of income

- Could you describe how Azelio is affected both positively and negatively being listed on the stock exchange?

- Does being on the stock exchange affect Azelio in terms of communication internally or externally?
- Since Azelio does not have a positive cashflow and investors can only believe that the valuation of Azelio is fair. Does this cause stress within Azelio to deliver good news?
- If you would receive a large order from a customer and you need to ensure that your suppliers are able to deliver accordingly, how are you managing this issue?
- At what stage of company growth do you think transparency regarding large orders etc. will be less of a problem in terms of insider trading?
- To what extent does your independence of income and negative cash flow affect demand planning at Azelio?
- At what point do you believe that organization can be more transparent internally and externally regarding the volatile stock and risk of insider trading?

Critical resources in the installation phase

- A unique variable in your "supply chain" is the installation phase which could be a bottleneck. Is this step seen as a problematic step in the process or more of a minor issue to manage?
- What kind of uncertainties can you see with this process step that can affect demand?
- To what extent does the installation phase affect demand planning at Azelio?

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